The FOUNDRY

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Castings Provide Ventilation for Taxi Stands

GROWTH of the automobile and development of the skyscraper have produced a traffic congestion in the centers of the larger cities of the country which is puzzling the minds of traffic experts. More and more, city officials are finding it necessary to apply restrictions on parking and stopping in certain areas. Around railroad stations, hotels, and other types of public buildings, it has become necessary to take the automobiles off

Cast Ventilators Expel Fumes of Automobile Exhausts from Taxi Stand

the street during the time that they are unloading and loading. In some instances, this is accomplished by building a taxi stand within a building. Examples of that system of handling traffic may be found at the LaSalle Street station in Chicago and in the new Union Terminal station at Cleveland. Ventilation, of course, becomes a problem, due to the deadly poisonous character of the fumes exhausted by the gasoline engine. Usually large fans pump enormous quantities of fresh air into these rooms near the ceiling and the contaminated air is drawn away at the bottom through registers placed in the bases of the supporting columns. Since these registers are in constant danger of receiving an unexpected, violent bump from a cavorting taxi, castings have been called into service. In addition to cast registers, castings are used in other parts of the ventilating system.

Find Where Castings Can Be Sold.

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Alabama Makes 65 Per Cent

Fig. 1—Cast iron pipe is shipped out of the south in immense quantity. This train of 50 cars carries the weekly out-

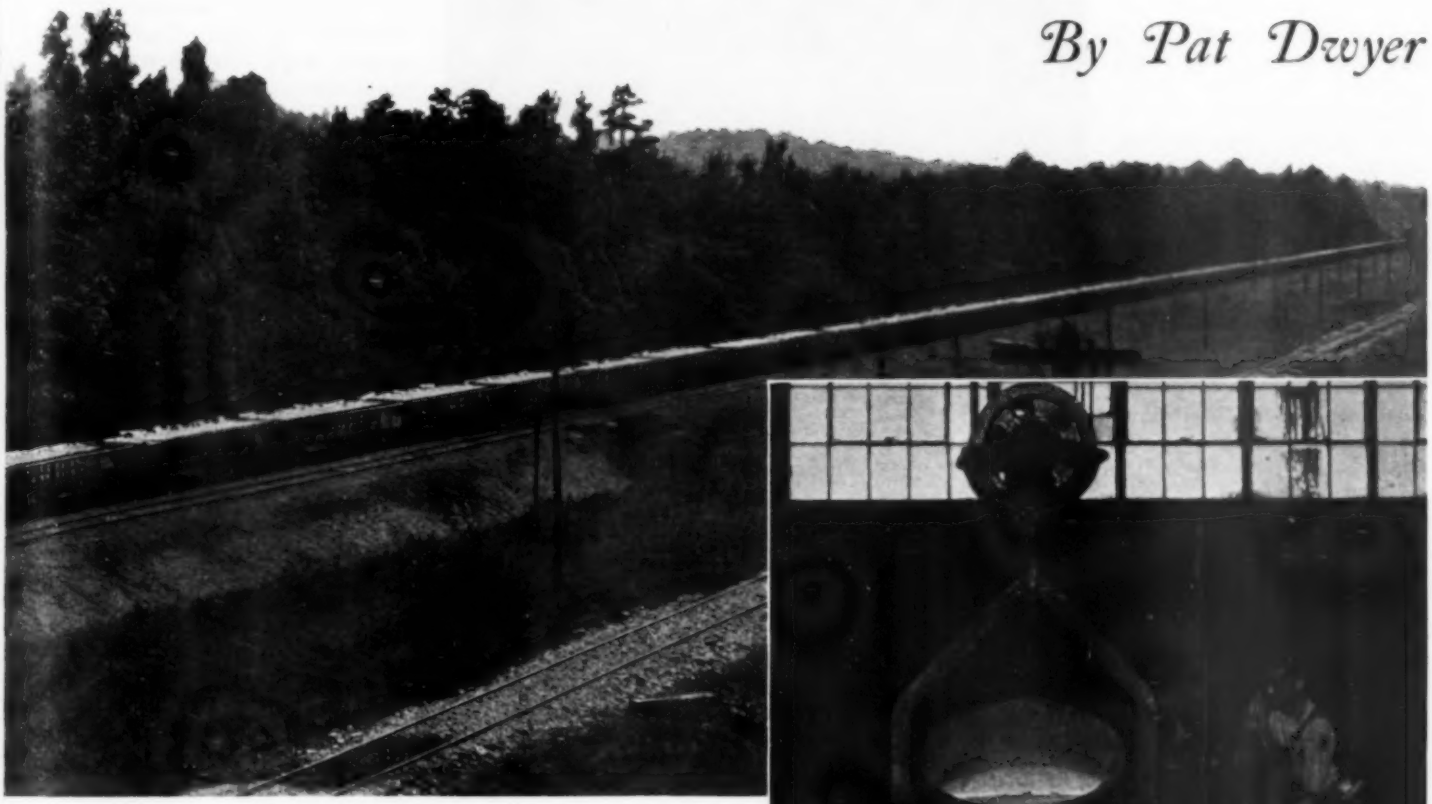
PIPE dreams, just pipe dreams," the wise ones said and shook their heads pityingly when men with pioneering instinct and prophetic vision first began to talk seriously of establishing a plant in the South to manufacture cast iron pipe. The idea was ridiculous. The great market for cast iron pipe was in the North. Long established, well organized plants in that section of the country were competent to take care of all present and anticipated needs far into the future. Financial interests betrayed no enthusiasm. In fact they were more conservative—if that is possible—than usual, when visionary gentlemen approached them on the delicate subject of advancing funds to try the experiment. They pointed to the financial straits of two or three small companies attempting to operate pipe shops in the border states of Virginia, Tennessee, Kentucky and the lower tip of Ohio. The idea of going further south, into central Alabama smacked of sheer imbecility and an abysmal ignorance of the great basic laws that governed economic conditions, transportation and supply the demand. In vain the promoters argued that the territory possessed inexhaustible supplies of iron ore, coal, limestone, clay and molding sand, all in such close juxtaposition that manufacturing costs inevitably would be reduced to a point that could not be duplicated elsewhere. To the objection that skilled labor was not available, they replied that native labor could be developed. Also, the history of all industrial sections shows that labor always has flocked to where steady employment is assured. The ability of these early pioneers to peer into

Comprehensive Series

THIS is the first of a series of articles dealing with the production of cast iron pipe in Alabama. Owing to the fact that the pipe foundries located in that state turn out considerably more than half of the total tonnage made in the United States it is natural to infer that manufacturing processes here have reached a high point of development in that section. Commencing with a historical and commercial background the series of articles will be developed to embrace descriptions of the methods and equipment employed in a number of plants for the production of pressure pipe by the old or standard process, by the centrifugal process in sand lined and in metal molds, and by the latest method in which the pipes are poured horizontally in green sand molds. Methods and equipment employed in soil pipe foundries will be described in one of the later numbers of the series which is scheduled to conclude with a description of a fittings plant and of another in which spiral culvert pipe is made. These two differ from the others in many respects but will round out the series.

# of Nation's Cast Iron Pipe

By Pat Dwyer



put of the Bessemer, Ala., plant of the Central Foundry Co.

Fig. 2—Special shapes are made in green sand

the future, their courage and resourcefulness in taking the plunge, the same determination and faith in the future, shown by their successors, have been amply justified.

Out of approximately 2,000,000 tons of cast iron pipe made in the United States in 1929 the South supplied 65 per cent.

Forty years ago when the first pipe shop was built in Alabama, Birmingham was an overgrown village with 30,000 inhabitants. Today it is a modern progressive city of nearly 300,000, embracing a dozen former small towns and extending along Jones valley for 18 miles from Woodlawn on the east to Ensley and Fairfield on the west.

The valley, 3 miles wide, is built up from side to side. The fashionable residential section has climbed up and over Red mountain on the south and rapidly is filling the far side and the succeeding valley. The flood of wealth that has poured into the valley is reflected in these magnificent residences and grounds, equalled by few and surpassed by no similar areas in any American city.

All the wealth represented on Red mountain has not been drawn from the pipe industry, but the pipe industry has contributed its share. It is no exaggeration to say that the first pipe maker to come to Birmingham, turned the spigot which started the golden stream flowing into this section of the South.

For the benefit of any who may be unfamiliar with the map, it may be said that Birmingham is situated almost at the southern end of the Appalachian range of mountains. A few miles south of the city the rolling country ceases and spreads out in a vast plain, known as the Black Belt of Alabama. The term was applied partly because the colored inhabitants outnumber the whites 2 to 1, but principally on account of the rich, black, alluvial soil, particularly adapted to the cultivation of all the semitropical fruits and vegetables.

Although Birmingham is the great pipe manufacturing center of the South, many large pipe plants also function in Bessemer, Gadsden, Agricola, Talledega and Anniston on the north and in Holt, to the south. Soil pipe and fittings are made according to long established practice in many of these plants. The method will be described in considerable detail in a later article of the present series. Pressure pipe in all commercial sizes is made according to several different methods. Some of it is cast vertically in dry sand molds in a pit. This is a method that has been in vogue practically from the beginning of the pipe making industry in this country on all lengths over 8 or 9 feet.

Fig. 3—Soil pipe and other pipe molded horizontally are poured from a multiple lip ladle

More recent developments in methods for producing cast iron pipe also are exemplified in several plants. At one the metal is poured into sand lined metal molds revolving at high speed horizontally. Centrifugal action throws the molten metal against the face of the mold and in that manner forms a tube uniform in section thickness.

At two other plants the deLavaud method of pouring metal into spinning, water cooled metal molds, is employed.

The most recent development, that of casting long pressure pipe horizontally, with green sand molds and cores, is practiced successfully in Birmingham at the plant of the McWane Cast Iron Pipe Co. Interesting features of these various methods, also of the plants where they are practiced, will be taken up in succeeding articles of this series. Manifestly the subject of pipe making in the South, with its almost endless ramifications, cannot be dismissed briefly.

More than casual reference is due a business employing 96,000 men, turning out 1,300,000 tons of pipe worth $65,000,000 and involving $135,000,000 in wages per year. A business that was established on a shoe string, against the advice of all financial and economical prophets of the day. A business that has attained its present magnitude in the comparatively short period of 40 years.

Old Time Pipe Men

Personalities loom up strongly both in the early establishment and later development of the pipe foundries of the South. The real pioneer was David Giles. Although he had no actual hand in the Alabama development, his example in setting up a pipe making plant in Chattanooga, Tenn., undoubtedly directed other men's minds toward the South. He was an extremely ingenious individual and many of the methods and pieces of equipment he invented have been adopted as standard and as such are employed throughout the entire industry. Bottom drying, the revolving pit, a special rammer and other devices and expedients, the product of his fertile brain, still find a place in regular practice and will be the subject of comment later. David's father came from Wales about the middle of the past century. He was a skilled molder with a touch of the wanderlust which brought him eventually to Nashville, Tenn. Here the boy David also became a molder and in 1867 established a small shop of his own in which he made hollow ware and general jobbing castings. In 1870 the State of Tennessee established a foundry in the Nashville penitentiary. No so called free and independent manufacturer can compete against an establishment that has no overhead, no pay roll, no labor problem, no notes to meet at the bank and no partners or stock holders to satisfy. David closed his shop and moved to Chattanooga where with two partners, Ibester, a patternmaker, and Llewellyn, a banker, he established a jobbing and pipe shop. Here his son T. G. Giles learned the trade, eventually became foreman and general assistant to his father and took over the managership when David died in 1910 at the age of 74. The company was absorbed by the United States Pipe & Foundry Co. in 1900 and still forms an integral part of that organization with the genial Tom Giles as resident manager.

A true democrat, proud of his practical skill and knowledge, familiar with every detail of operation and administration, a benevolent autocrat in his own domain, he climbs into his handsome motor car at noon and his negro chauffeur drives him downtown to a modest eating place where he

Fig. 4—Substantial brick foundry operated by D. Giles & Co., in Chattanooga, Tenn., in the early eighties. Note the runway leading up to the cupola

orders corn beef and cabbage and puts it away with the same gusto, speed and skill he displayed when he was a husky young molder of twenty-one.

Early pipe makers were hardy men who worked hard, played hard, ate and drank what they pleased and when they pleased and lived to a ripe old age. One of the pleasant customs was to roll a keg of beer into the shop in the afternoon. If they succeeded in "running a ring around," a familiar term for pouring the entire pit without a waster, the keg was tapped and the contents employed to irrigate the thirsty crew. Instances are on record where an occasional waster that might have interfered with the program, conveniently was overlooked. Inspectors were conscientious, but they were not infallible.

Fortune of War

In 1889, J. K. Dimmick, with capital furnished by Procter & Gamble, the soap men of Cincinnati, leased a small plant in Anniston, Ala., and made pipe there until a new plant was completed in Radford, Va. The Anniston plant then was closed and operations transferred to Radford. Dimmick later returned to Anniston, bought the plant and operated it until 1899 when the United States Pipe & Foundry Co. was formed to take over and operate pipe shops in Anniston, Bessemer, Ala., and at Chattanooga and South Pittsburg, Tenn.

A few years later Dimmick built a plant in Birmingham and rode high on the crest of prosperity until one of the vagaries of the war forced him into bankruptcy. This incident probably is the first of a long list that afterward gave rise to the phrase, profitless prosperity. Naturally the many kaleidoscopic changes which marked this period had been responsible for many varying stories. One that is freely circulated has it that the company booked an order for $3,000,000 worth of large pipe for the Argentine republic to be delivered over a reasonable period in Buenos Aires. Production was

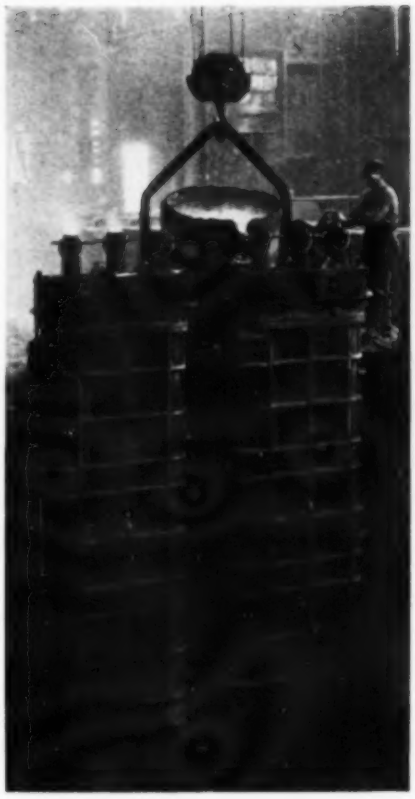


Fig. 5—The runner is arranged to pour the three pipes simultaneously

rushed and the yard was filled with pipe while the management made frenzied effort to secure shipping accommodation. The war embargo was on. The government had pressed every available bottom into service. Every shipward on the Atlantic, the Pacific and the Great Lakes was working night and day on war orders. Not a vessel could be had for love or money or through political influence. Uncle Sam was on the war path, pouring men, money, munitions and supplies across the sea. War hysteria was at its height. A private interest had as much chance of chartering a cargo carrier as a child would have of sneaking a battleship out of League Island navy yard and towing it up Broad street in his little red wagon.

"I don't know how long this job is going to last" the old war eagle cried belligerently ruffling his neck feathers "but when I start a job, I finish it. You can get the boats when I am through with 'em, and not a doggone minute before!"

The contract was canceled and the company was broke with thousands of tons of unsalable pipe in the yard. The pipe was made to metrical measurements and therefore could not be absorbed readily in the home market. Eventually most of it was disposed of to various interests, particularly new installations, where a few special fittings, combining the metrical with the ordinary English measurements, served to connect the two varieties of pipe. However this did not happen until long after the plant had been put on the auction block and had been bought by the United States Pipe & Foundry Co. It is still operated—on a greatly expanded scale—by this company and is interesting as the first plant in the United States to make pressure pipe by the de-Lavaud process.

Stories Vary

Attempt to verify this story brought the following comment from a man who has been identified prominently with the pipe making industry in the South for many years: "I don't believe that foreign export story is correct. As a matter of fact I don't think the Dimmick company ever handled much export business. Over expansion was a big contributing factor to the failure. Along about 1903 or 1904 the company completed a separate plant unit for the manufacture of large diameter pipe and a contract subsequently taken for a large quantity of this pipe was the finishing blow. However, this contract covered pipe for an American city and not for Buenos Aires."

Fig. 6—White members of the shop crew of D. Giles & Co., Chattanooga, Tenn., in 1890. T. G Giles, present resident manager of this branch of the United States Pipe & Foundry Co., at that time was shop foreman and is shown second man from the left

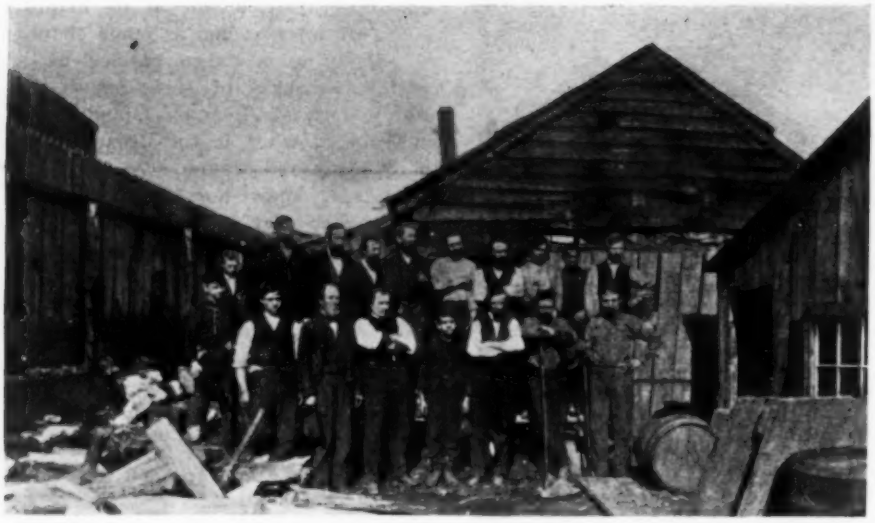


Fig. 7—Whiskers still were fairly popular when this picture of D. Giles & Co., foundry crew was taken in Nashville in 1870, shortly before the business was moved to Chattanooga

"War"—if the late General Sherman has been quoted correctly all these years—"is hell." It may be that the general spoke a little hastily and based his opinion entirely on the scenes of devastation and loss that followed his triumphal march to the sea. Men who made pipe, sold them and then found they could not deliver them or collect on them, undoubtedly endorsed General Sherman heartily. By a curious coincidence the war proved a fairy godmother to another Birmingham pipe shop newly erected and placed in operation in 1914. Domestic orders due directly to war conditions rolled up a surplus in one year's operation sufficient to pay for the erection of the plant.

First Pipe Shop

Early reluctance to establish a pipe plant in the South is in marked contrast to the activity which has characterized the industry ever since. New and larger plants sprang up with astonishing rapidity. Men beginning in minor capacities in one plant forged to the top and branched out in new establishments. Others, beginning at the top, split away from the parent organizations and built new plants of their own. Many of the men prominent in the pipe industry of the South have been connected at various times with several companies. Other men have retired or have entered other lines of business.

Shickle, Howard & Harrison of St. Louis built the first pipe plant in Bessemer on the outskirts of the present city of Birmingham in 1889. This company built its own battery of coke ovens to supply gas for drying the molds and cores. With the establishment later of blast furnaces and extensive by-product coke plants in the district, the supply of gas became so ample and the price became so low, that the foundry coke ovens were abandoned. At present all the pipe shops and other large industrial users of gas enjoy rates as low as 19 cents per 1000 cubic feet. The cost may be still further reduced on the completion of a natural gas line from Louisiana, now under construction and extending to Atlanta, Ga., on the east. The Alabama Power Co., with a practically unlimited and inexhaustible source of power in the Tennessee and Warrior rivers, supplies electrical energy at equally favorable rates.

The late Louis Hoster Sr. came to Alabama as secretary and manager of the Howard & Harrison plant and operated it until it was taken over by the United States Pipe & Foundry Co., in 1900. Then he withdrew and organized the Bessemer Foundry & Machine Co. to handle a general line of large miscellaneous fittings and general castings. The plant now is operated by his son Louis Hoster and still continues to turn out some of the largest and most complicated special pipe fittings made in this country.

Major R. A. Bull, for the past several years director of the Electric Steel Founders Research group, Chicago, at one time served as foreman of the pipe run and chief inspector at the United States Pipe & Foundry Co. plant in Bessemer. Many other men who afterward attained prominent positions in the foundry field, received part of their early training in this old plant. Incidentally, the first 72-inch pipe made in this country was a product of this plant.

History of the pipe making industry in the South and the men connected with it, present all the elements of romance, adventure, drama and human interest to a remarkable extent. The late Miss Charlotte Blair for many years played a prominent part in making this history.

Enter Miss Blair

Member of a socially prominent South Carolina family, Miss Blair in early life showed that independence of spirit and capacity for handling large affairs which characterized her actions later as an important member of the group which made cast iron pipe history in the South. Ignoring the coventional southern attitude of the day in regard to woman's place in the community, she elected to take up a business career. She and E. E. Linthicum—now president of the National Cast Iron Pipe Co.—were both connected with the Southern Pipe & Foundry Co. at Anniston, but in the general shuffle following the sale of the Anniston plant to the United States Pipe & Foundry Co., Miss Blair

Fig. 8—A special device suspended from a locomotive crane, hooks nine pipes at one time and loads them for shipment

was transferred to Chattanooga which plant had been formerly operated by the American Pipe & Foundry Co. Mr. Linthicum remained with the Anniston plant after the U. S. Pipe & Foundry Co. took it over, and was for a number of years, resident manager of this plant. Miss Blair was in Chattanooga only a short time, when she joined J. K. Dimmick in organizing the Dimmick Pipe Co., which plant was built and began operations in Birmingham August 17, 1900. She was secretary and directed sales of this company until May, 1904, when she resigned. It is said that Miss Blair was the first woman to serve on the board of directors of a corporation in the state of Alabama.

Golden Rule Egan

This resignation afforded Miss Blair a short breathing space in which to complete her plans which contemplated the establishment of the largest and most elaborate pipe plant in the country. Through her brother Jas. W. Blair, she succeeded in interesting the late J. J. Egan in the project to the extent of investing a large part of a fortune left him by his uncle. He was president of the company from 1905 to 1915, chairman of the board of directors from 1915 to 1921 and president again until he resigned two weeks before his death in the early part of 1924.

Most of his presidential activity was exercised from Atlanta where he always maintained his home and where he was interested in many other enterprises. The actual work of building a plant and developing a market fell upon the shapely and capable shoulders of Charlotte Blair and E. E. Linthicum. Paul A. Ivy, a nephew of Miss Blair, took service under her banner in the beginning as a member of the sales force. Eventually he became general sales manager, secretary and vice president, and held these positions until 1927. For the past 18 months he has been vice president of the National Cast Iron Pipe Co.

Miss Blair severed her connection with the American Cast Iron Pipe Co. in 1909 and retired to California for a complete rest. Her health had suffered to some extent through her intense application to business and this rendered her extremely susceptible to the severe shock she received when a favorite nephew was killed by an electric train. She did not long survive. She died in 1917, but her name still is quoted freely in any pipe-making discussion.

Memory of E. E. Linthicum, president of the National Cast Iron Pipe Co., recently merged with James B. Clow & Sons, Chicago, carries him back to a small store in Chattanooga where as a boy he clerked for his father and watched the activities of the pipe makers in a shop across the street. This scene presented features of which he never wearied, but the magnificence of Major Downing, the owner, was what finally fired his ambition to become connected with the industry. According to all accounts the handsome major was what sometimes flippantly is referred to as an *eyeful.* Dignified, handsome, dressed in broadcloth and sitting his powerful chestnut horse with the ease and grace of a cavalry officer, he excited the envy and admiration of every boy on Whiteside street. His dashing progress was marked by a procession of stray dogs and chickens flying to right and left. In rainy weather, the pounding hoofs of his charger threw up a cascade of mud from the unpaved street, comparable to the bow wave of a battleship.

As a preliminary to one day emulating the gallant major, young Linthicum secured a job as clerk with the Southern Pipe & Foundry Co. in Anniston. Industry, application and earnest desire to master all the details of the business won him steady pro-

(*Concluded on Page* 106)

Fig. 9—First 72-inch pipe in the United States cast at the United States Pipe & Foundry Co., Bessemer, Ala., in 1897. *1—Ben Clarke, pit foreman. 2—Tom Dowling. 3—F. B. Nicholls, general manager. 4—William Perkins, general yard foreman, afterward manager at Addystone, O. 5—John Thompson, superintendent. 6—Louis Hoster, Jr. 7—H. F. Mundes, patternshop foreman*

Many Pipe Shops

SEVERAL pipe companies operate groups of foundries scattered through many towns and cities. For example, the Alabama Pipe Co. operates shops in Anniston, Ala., under the titles of Alabama Pipe Co., Standard Foundry Co., Union Foundry Co., and Ornamental Foundry Co. In Gadsden, Ala., the same company operates plants under the names of Coosa Pipe & Foundry Co., Agricola Pipe Co., and Gadsden Pipe Co. The Superior Pipe Co. is conducted in Bessemer, Ala. The Talladega Pipe Co., in Talladega, Ala., and the Rabe Pipe & Foundry Co., in Chattanooga, Tenn., Independent pipe shops in Anniston include Anniston Soil Pipe Co. and Rudisil Soil Pipe Co.

The Central Foundry Co., New York, operates large foundries in Anniston, Bessemer and Holt, Ala. The United States Pipe & Foundry Co., with headquarters in Burlington, N. J., operates pipe foundries in Anniston, Bessemer and Birmingham. The American Cast Iron Pipe Co., a self-contained unit for the production of pipe either by the pit method or by the sand spun process, is located in Birmingham. So is the plant of the National Cast Iron Pipe Co., where a considerable part of the total output is made according to the deLavaud process. Pressure pipe is cast horizontally in green sand molds at the plant of the McWane Cast Iron Pipe Co., Birmingham.

Cupola Malleable
Is Cast in Permanent Molds

By Harvey W. Hyde

ATTEMPTS to use metal molds for general foundry practice date back many years. Nearly every foundryman has made trials of this apparently simple and ideal method for the production of castings with varying success. However, in a great many cases complications in the use of these molds have resulted in abandoning the experiments. The largest measure of success has been obtained in the gray iron field, and several firms are employing metal molds. Application of this method in the malleable iron field is more recent, and, because of inherent difficulties with white iron, more troublesome to operate.

Applies Principle

Since the application of iron molds to malleable practice has been placed on a practical basis, many foundrymen may be interested in a description of the experience gained in an intensive study of the method which has extended over a period of a year and a half. Observations were made on castings of fairly heavy section made from cupola malleable. The method has been advanced through experimental stages to a productive point.

Broadly speaking, metal molds are classed as permanent molds. The general term is too broad for proper understanding of the work being done and should be subdivided about as follows:

Permanent molds are those in which the entire casting is made against a metal surface. Die castings are the most important group in this class.

Semipermanent molds are those in which a part of the casting is made against a metal surface and part is made against a destructible core. Most of the work in iron belongs to this class.

Refractory molds are those molds which are made of a refractory material such as fire clay, zirconia, etc. This class has had much experimental attention and has been used satisfactorily in some work, but as yet it has not reached any economic importance.

Chill molds are the same as the semipermanent molds and the term is applied particularly to malleable work where the rapidity of cooling is the effect most desired. This term will be used frequently in the following pages.

Nearly any type of a casting can be made in a metal mold. However, there are economic limits that control its application on account of size, shrinkage, mold construction, etc. Automatic production of small pieces may be accomplished in some cases, but the indications of this investigation are that malleable iron from a cupola is not adapted to small work nor to automatic machinery. Best results have been obtained with castings of fairly large and heavy section. Pieces weighing up to 200 pounds and as thick as 1¾ inches have been made satisfactorily during the progress of this investigational work.

Aside from a better appearance of the finished casting, the chill mold provides rapid chilling of the metal from the exterior and consequently reduces liquid shrinkage and its resulting flaws. The metal is solid for a greater distance through the cross section of the casting and there is a reduction in the danger of leakage in castings having to stand a pressure test. Those who are familiar with malleable work in thick sections know the tendency for spongy spots to form at the junction of light and heavy sections. This same tendency is present in chill mold castings, but its effect is reduced greatly.

During the past few years there has been a decided trend toward the melting of malleable in a cupola, especially in highly competitive lines, where the advantages of a continuous metal supply and cheap melting are needed. Chill molds are a help in foundries of this class, since white iron may be made from a mixture that ordinarily would be mottled or black in sand castings of the same section. By melting a mixture giving a white fracture in thin sections for the bulk of the sand work of the foundry and using chill molds for the larger and heavier pieces, the range of work and quantity produced may be increased without the difficulties of changing mixtures.

Gives Clean Surface

A superior surface is obtained in the proper use of chill molds. The face of the mold may be lettered as desired and the casting will show a fine impression of this marking. There is nothing adhering to the outside of the casting and the scale is slight in amount. Core sand can be removed easily from the interior of the casting if proper sand and low pouring temperatures have been used. A slight sandblast or shot flotation is all that is required to give a perfect surface.

Chill molds also serve to increase production per unit floor space and decrease labor cost because of operating characteristics. Castings will show a greater uniformity than those made in sand. Another feature of chill molds is the fact that defects that will scrap the casting are more apparent before the casting has been put through the balance of the process necessary for its preparation for the trade, and money is saved in not performing unnecessary work.

Chill molds may be made from any

Develops Application

FOR many years considerable work has been done by various investigators with the object of removing the obstacles which have prevented the practical application of metal molds to the production of castings in various ferrous alloys. For certain types of gray iron castings permanent molds have been employed successfully, but it is only recently that a practical application of this process has been developed for producing malleable iron castings. This is the first of a series of two articles describing various phases in the development and application of iron molds for cupola malleable practice.

gray or malleable iron mixture that is the daily product of the foundry. However, better results will be obtained in the life of the mold, if close attention is paid to this part of the method. Normal gray iron is the easiest metal to use, and with proper care in its use in service, will give a mold life of about 500 castings. The addition of nickel and chrome in the ratio of 2 to 1 up to the point of unmachinability shows great improvement over straight gray iron.

If hard iron is used as a base, it must be treated with nickel or silicon to produce a gray machinable casting. Nickel gives better results than silicon as it appears to produce a finer graphite flake and more uniformly hard metal. Cracking of the mold is the serious defect of chill mold process. Nickel, because of its effect upon the graphite, assists in resisting this tendency for the mold to crack during use.

Graphite Causes Cracks

The graphite content of the metal used to make molds is the eventual cause of failure. Cracks, forming in the mold face under the strain of heating and cooling, as shown in Fig. 1, follow the cleavage planes of the graphite flakes. The exposed graphite and the oxidation of the metal prevents these cracks from closing completely after each pouring. The action is progressive and fissures open that cause the mold to be unfit for use. For a while, these cracks may be peened together, but the remedy is temporary and the effect is lost after a few castings have been made. This condition of cracking localizes itself in that point of the mold most severely heated as the casting is poured.

The combined carbon content of the mold is not important other than if it is near the white or mottled fracture, the mold has no ductility to resist the expansion under heat and the mold will soon split. The higher the combined carbon the easier the mold seems to fuse to the casting under incorrect operating conditions.

Manganese, added to bring the content of the metal to 0.65 to 0.75 per cent serves to toughen the matrix and seems to assist in the resistance of the mold to cracking.

From their general characteristics, sulphur and phosphorus should be as low as possible, since their tendency is to produce a brittle material. However, satisfactory mold life has been obtained with a mixture containing 0.12 per cent sulphur and 0.80 per cent phosphorus.

Use of cast steel as a mold material, especially with additions of nickel and chrome to produce heat resisting qualities, gives promise of being satisfactory. Cast steel is difficult to handle to secure the fineness of finish desirable in the mold and presents a problem in obtaining the lettering in the mold. It also is hard to machine when the proper amounts of alloy are added.

Patterns for the molds may be made in any convenient manner. The method which has proved most satisfactory in the work carried out, is the manufacture of a plaster cast over a wooden dummy. If the plaster is to act as the master pattern, allowance for only two shrinkages is necessary in the dummy. More satisfactory results have been secured by making a pattern from a plaster cast in the form of a thin aluminum shell to form the interior of the mold. This, after machining, is lagged with wood to give the proper thickness and contour that is desired for the mold. A master pattern of this type has a long life and gives superior work in the sand. The plaster patterns are fragile and are too heavy for convenient handling and their useful life is short.

For simple air cooled molds, the general contour of the casting to be made should be followed as closely as possible. Roughly, the mold section should be three times as thick as the casting. There is no definite rule for this factor and common sense is the best guide to follow. Heavy mold walls give a better mold life as it prevents splitting and warpage under use. However, in large pieces it is often impossible to maintain this factor as the molds become too heavy and bulky for handling when the rule is followed.

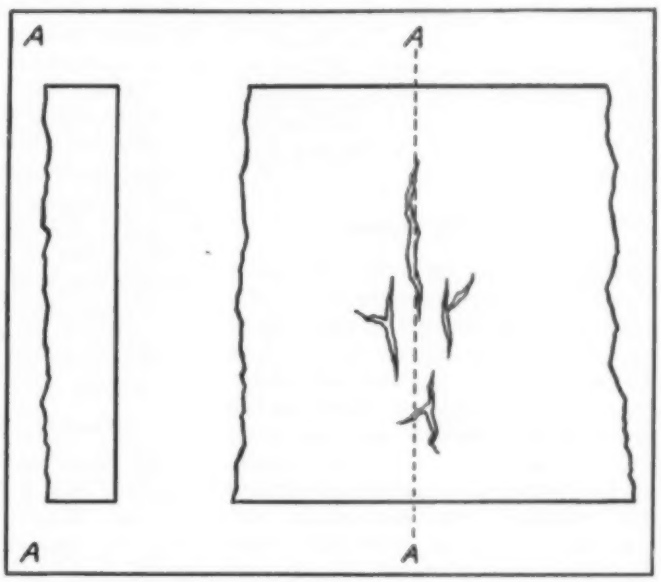


Fig. 1—Showing the Nature of the Fissures Which Develop in the Mold Due to the Impinging Flow of Molten Metal

It is necessary to have sufficient metal in the mold to provide ample heat capacity for the rapid removal of heat from the liquid metal when the mold is at its operating temperature. This removal of heat must be as rapid as possible without causing strains from irregular cooling. Thin mold sections are prone to split under the expansion and contraction of local heating, and large differences in cross section have the same effect. Fins, placed on the back of the mold, increase the area for the dissipation or absorbed heat and allow more rapid use of the mold.

The interior of the mold, against which the metal is to be poured, should be cast as near to size as possible. The original casting skin assists in the resistance to failure from cracks and the machining time is reduced. Skilful molding, the use of a good facing, careful blacking and thorough drying are necessary to make a good mold. Dry sand cores can be used for the interior or drag side, but with care, green sand molding will give good results.

Any lettering that is desired in the mold face can be secured by making a cast iron plate of the proper contour with letters on it as they are to appear on the final casting. This plate is rammed up in the mold. The surface of the plate must be protected from rust and holes for venting should be provided. These holes are filled with parting sand before pouring so metal will not fuse the plate to the rough mold. The plates containing the letters should be heavy enough to prevent fusion of the plate and mold casting, yet not so heavy as to prevent complete annealing of the casting from its own heat. Any chill

effect at this point will cause the mold to crack in service.

The parting of the mold should be made symmetrical if possible so that one pattern will do for both halves. For ease in removal of the casting from the mold, it is poured best in a vertical position. Attention must be paid to the fact that where ever metal in the casting must unite over a core or a part of the mold, the section at these points must be as heavy as possible. Thin metal at these points will result in cold laps and seams.

The information given deals only with simple air cooled molds. Good results have been obtained in some cases by the use of oil as a cooling medium. Attempts to use water or steam for this purpose have not been successful as the heat capacities of these media are too great. To get the effect of cooling for rapid production, the wall of the mold between the cooling chamber and the casting must be thin.

Cools Too Rapidly

Rapid removal of heat with water vapor causes severe strain on this mold wall and it is apt to split. Serious explosions may be caused from leakage of water into the mold chamber. Application of a liquid cooling agent depends largely upon the shape of the casting to be made. Design of the mold must be such that strains are equalized over the whole unit. For the work upon which this paper is based, there was no decided advantage to be gained in the use of a cooling agent other than air, and only a limited amount of work was done in this field.

As previously stated, machine work should be reduced to a minimum both for the sake of costs and better service of the mold. Finishing consists of machining the face of the mold at the parting line to the proper point and roughing a section on the back for the support in the operating machine. Any fins or irregularities in the mold cavity are removed, and, if necessary, the mold is ground to gage. Corners in the mold cavity should be filleted. Malleable iron poured at the proper temperature will not fill sharp corners, and such points cause a weakness that will be the starting point for cracks.

All molds must be vented amply. This is cared for by cutting V-grooves 1/16 x 1/8-inch at the core prints which lead to the outside of the mold. There should be plenty of these. Their presence will not affect the casting as the metal does not flow into them. In operation these vents must be watched to see that they do not plug up with soot and oil from the burning cores. Any pockets, where gas may be trapped should be vented along the plane of parting. This venting is important because, owing to the sluggishness of the metal as it nears the top of the mold, a slight back pressure will prevent the metal from filling the mold completely. The mold is the base of the process and too much attention cannot be paid to its manufacture and care to obtain the best results from this method.

For the operation of the molds, the simplest form of machine was used. From the experience gained, it was found that, as the machine became more complicated the trouble experienced under working conditions increased. Where maximum production of small work is desired, the automatic machines would be advantageous, but in malleable work particularly, machine operations must be flexible to care for the change necessary in cooling time, pouring temperatures, mold cleanings, etc. Since white iron is melted hot in the cupola for sand work, it has to be cooled before it is suitable for chill molds. This cooling is not satisfactory when hastened by the addition of scrap as a difference in temperature between the top and the bottom of the ladle may result.

Describes Machines Used

The machines used for this work consisted of a frame, stationary pedestal and slide. The frame must be rigid to maintain accurate meeting of the mold halves. The molds may be mounted by grooves, dovetails, or bolts, and there should be adjustable means provided for their location on the machine. The mounting of the molds is of some importance as it is rather difficult to adjust and handle them while they are hot. As an added precaution the molds should be provided with short blunt dowel pins and corresponding holes so that the parting line will be held true when the molds are closed.

A simple lever and toggle actuate the sliding half of the mold and lock it in place against the pressure of the metal during pouring. In the large sized molds and the equipment for their operation, the lever and toggle do not exert sufficient force to move the slide portion of the mold. Therefore, compressed air or hydraulic cylinders are used on these with great satisfaction.

All sliding parts of the machine should be protected from sand, foundry dirt and spilled metal. Sand from the cores will cause severe wear and will result in difficuty in operation. Spilled metal will often lock the machine so that the mold halves will have to be pried or sledged apart. Rollers under the slide help in the ease of operation of the machines but these are clogged easily and, in case of their use, means must be provided for their removal for cleaning and adjustment. The slide of the machine will expand more under the heat absorbed from the mold than will the frame. This is because the bearing surfaces act as an insulating joint in the heat transference to the frame. Unless provision is made for this feature, the slide will bind at the rear of the machine when the molds are open.

AlabamaMakesManyPipe

(*Concluded from Page* 103)

motion until he arrived at his goal as resident manager of the plant.

With Miss Blair, as formerly stated, he helped to organize the American Cast Iron Pipe Co.—known familiarly as Acipco—and served as general manager until he resigned in 1908 to organize the National Cast Iron Pipe Co. He has been president of this company since its organization.

Other men who have taken a prominent part in the development of Acipco over a period of years include J. F. Kent, J. R. McWane and W. D. Moore the present president.

Mr. Kent with a long record as a successful rolling mill manager introduced continuous operation, the double shift, into the pipe making industry. His proposal to double the 150-ton capacity of the plant was treated as the idle boast of a rank outsider rushing in where angels feared to tread. One choleric gentleman declared that he would eat every ton of pipe made over 200! Fortunately he was not held to his promise. The output of the plant rose to 250, 300, 350 and ultimately to 400 tons per day.

J. R. McWane, a molder by trade, an ordained minister by profession, a man of singularly forceful and original ideas, has played a prominent part in the development of the cast iron pipe industry in the South. Reference to his varied activities will appear D 2:15 R 11:36 S 7:35 am
more appropriately in a later article devoted to description of the plant of the McWane Cast Iron Pipe Co.

The same applies to W. D. Moore who joined Acipco as a draftsman and engineer, who introduced many innovations, developed the sand spun process of casting pipe and has been president of the company since 1924.

This is the first of a series of articles dealing with the cast iron pipe industry in the South. Succeeding articles are scheduled for publication in early issues of The Foundry.—The Editors.

Gray Iron

Possesses

Valuable Engineering Properties

Part II

A FEW years ago cupola irons with 40,000 pounds per square inch tensile strength were considered unusual. Today many foundries maintain this figure in their everyday practice and think nothing of it. Some foundries, using special processes, can consistently make irons with a tensile strength of 50,000 pounds per square inch, occasionally running up to 65,000 pounds per square inch. The stronger irons have much higher apparent modulus of rupture, hence are more rigid. Such irons are useful in certain applications. Yet universal usage of high strength irons is neither necessary nor desirable. Often an iron of reasonable strength will meet all the service demands with an ample safety factor (not the 15 or 20 sometimes employed) and be more economical.

Most tensile test figures given in gray iron literature are obtained on separately cast test bars, usually on the so-called arbitration bars, 1.20-inch diameter. The properties of gray iron are influenced by change in cooling rate to a greater degree than are those of most metals. Gray iron becomes lower in strength as cooling rate is retarded, or as section size increases. This lowering in strength usually is most marked in sections ranging from ¼ to 2 inches. As shown in Fig. 1 some irons are affected much more than others. Since the designer is interested primarily in the properties of the casting it is necessary that he be furnished some means of interpreting test bar results in terms of what may be expected in the castings.

American metallurgists recognize this condition and much work is being done to correlate properties of castings and test bars. The British have proposed use of three bars (0.875, 1.20 and 2.20 inches in diameter) to cover the usual cases in engineering practice. To make tests on the casting often is cumbersome, expensive, and inaccurate. A close approximation is obtained if bars be cast twice the diameter of the average or of the most important section in the casting. These bars approximate the conditions in the casting and if anything are on the conservative side. The calculations and proofs of this correlation will be presented in a later section of this series of articles.

Greater strength with increased rigidity of some irons can be employed advantageously in modern design, both to reduce undesirable weight where cast iron now is used and to substitute in places where much more expensive materials are used at the present time. It seems that there should be a real field of application for these stronger irons which are intermediate between ordinary gray irons and cast steels in many of their properties.

Wear resisting properties of gray iron are unusual and perhaps too little appreciated. First of all gray iron has high brinell hardness in comparison to its easy machinability. Locomotive cylinders, automotive cyl-

Are Developing Tests

WHILE the tensile strength values of gray cast iron generally are taken from separately cast test bars, considerable work is being done to correlate this with properties that may be expected in the castings. A close approximation is made by casting a bar with twice the diameter of the average or most important section of the casting. Such a bar will have approximately the same cooling condition as the casting. In addition to discussing these factors, this article, which is the second of a series on the engineering properties of gray iron, continues the description of the various properties of the iron and corrects some erroneous impressions on these properties.

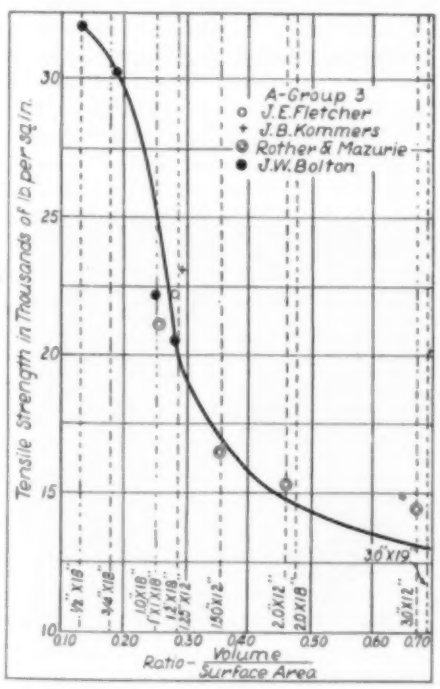


FIG. 1—CHANGE IN SECTION VARIES THE STRENGTH

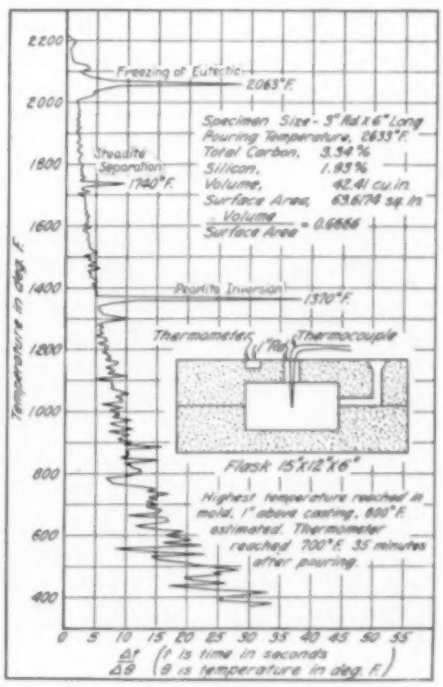


FIG. 2—COOLING CURVE OF THE SOLIDIFYING METAL

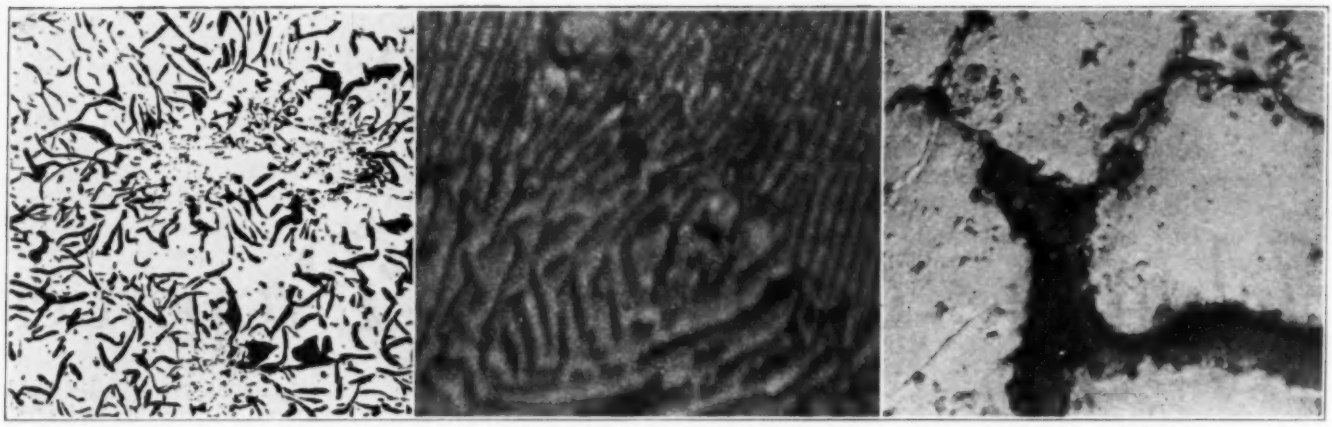


FIG. 3—GRAPHITE SHOWN AS BLACK FLAKES. NOT ETCHED, 50 DIAMETERS. FIG.4—PEARLITE STRUCTURE ETCHED WITH PICRIC ACID, 2500 DIAMETERS. FIG. 5—POLYGONAL GRAINS OF FERRITE ETCHED WITH PICRIC ACID, 700 DIAMETERS. DARK PENCIL IS GRAPHITE FLAKE

inders and diesel cylinder liners are examples of severe service conditions involving wear, pressure, and elevated temperature, satisfactorily preferred by gray iron castings. Recent research by N. L. Mochel, *Proceedings*, American Society of Testing Materials, 1928, throws light on the exceptional resistance of gray iron to seizing or galling, even at elevated temperatures and high pressures. In his experiments he compared various steels, stainless steel, monel metal, nitrided steel, gray iron and other metals. The gray iron samples showed no tendency to seize or gall, either with iron to iron contact or with the other metals with which they were placed in contact.

An experience in heavy machine tool design will illustrate this phase. An experienced designer, familiar with the good wearing properties of gray iron, had arranged for a heavy steel bar to work through a gray iron sleeve. Pressures were high. The iron wore well, but there was some slight cracking away at one end of the sleeve, as no relief was provided. Bronze was substituted and it squeezed out of shape. Hardened steel plates were used and bad wear was encountered.

Many old timers are familiar with the good wearing properties of cast iron. They attributed these to the lubricating power of the graphite. This explanation is problematical, the more approved one being that the heterogeneous structure of gray iron furnishes the structural contrasts of harder components embedded in more plastic ones as found in nearly all good bearing metals such as the babbitts and bronzes. More homogeneous metals tend to seize readily once certain pressure intensities are exceeded. It is held that the best wearing irons are those of pearlitic matrix and rather low in carbon, hence the higher strength metals.

Has Bearing Properties

The previously mentioned considerations are related in metal to metal wear. Where severe abrasion is encountered, harder metal, such as chilled iron, is preferable. Wire drawing and erosion are resisted better by the close grained irons than by the softer grades. Lacking exploitation it is doubtful that these good wearing properties of iron are widely recognized or taken full advantage of in design. It is probable that many bearings could be made satisfactorily of this metal. An expert with one of the largest nonferrous bearing manufacturers in this country once mentioned several places where after many trials of the best bronzes, gray iron bearings were put in and performed satisfactorily. Proper grades of gray iron work well in certain gears where steel castings wear too rapidly and hardened alloy steels are needlessly expensive. Many other applications will occur to the wide awake designer.

Fatigue resistance of gray iron has been studied by Moore, Kommers, Lyon, and others. Definite fatigue limits have been established as one-third to one-half the ultimate strength and roughly proportional to ultimate strength. No fear need be felt about alternating stresses if these are restricted to a reasonable percentage of the ultimate strength and the metal is not subjected to corroding influences.

Up to some 800 degrees Fahr. good gray irons lose little if any strength

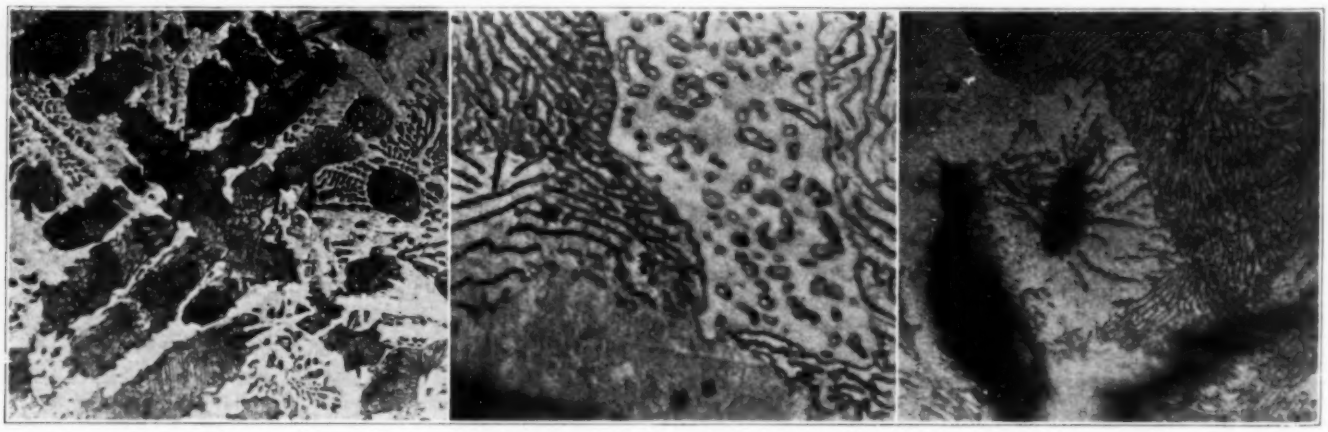


FIG. 6—SAMPLE CONTAINING 4 PER CENT PHOSPHORUS SHOWING STEADITE AS WHITE CELLULAR FORMATION. DARK MATERIAL IS PEARLITE. FIG. 7—STEADITE (CENTER) IN GROUND MASS OF PEARLITE. ETCHED WITH PICRIC ACID, 2000 DIAMETERS. FIG. 8—INCLUSION, PROBABLY MANGANESE SULPHIDE, SURROUNDED BY PEARLITE THREADS PERSISTING IN FERRITE AREA. PICRIC ACID ETCH, 484 DIAMETERS

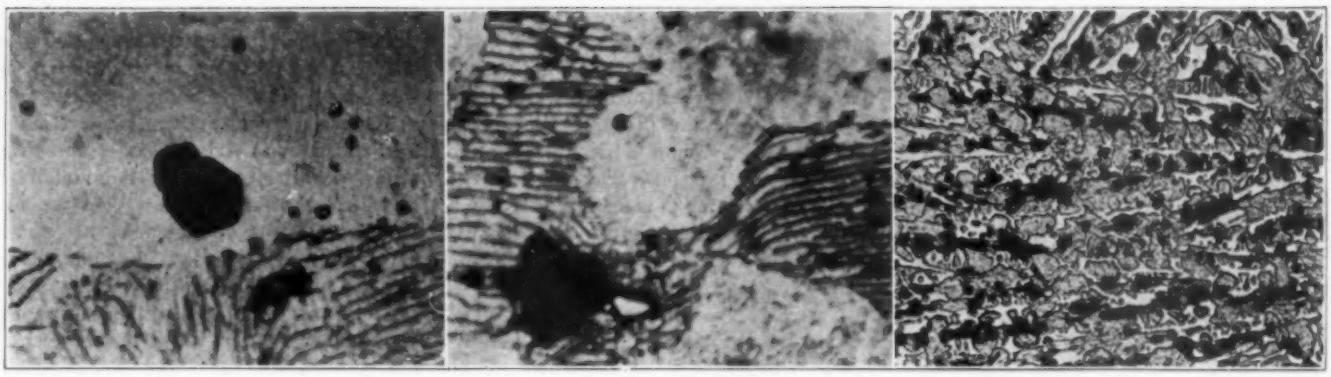


FIG. 9—INCLUSIONS IN GRAY CAST IRON. FIG. 10—SAME AS FIG. 9. THESE INCLUSIONS MAY BE EITHER SILICATES OR SULPHIDE INCLUSIONS. FIG. 11—MOTTLED STRUCTURE. THE WHITE AREAS ARE CEMENTITE, BLACK-GRAPHITE, AND GRAY-PEARLITE AUSTENITE. ETCHED, 75 DIAMETERS

as measured on short time tests as explained in a later section. At 1000 degrees Fahr. gray irons have some tendency toward graphitization although this is slow. At 1200 degrees Fahr. graphitization and consequent permanent weakening of the metal proceeds steadily, while over 1300 degrees Fahr. it is quite rapid. Growth in gray iron arises from two causes. One, graphitization, requires high temperatures, as mentioned. However, the second cause, internal corrosion is more dangerous since it is less understood by engineers. In open grained irons the paths along the graphite flakes are nearly continuous. Hence gases and liquids can seep into the metal through these tiny orifices and set up internal corrosion. The condition somewhat resembles intercrystalline corrosion in other metals.

The facts are that properly made irons have given successful and continuous service with moderately superheated steam and various fluids in stills, autoclaves, acid eggs and many other places which demand resistance to growth. As a rule irresponsible and ill informed manufacturers usually are the ones responsible for the comparatively rare cases of growth over which so much discussion has been centered.

Gray iron is a reliable and modern material of construction. By careful selection of proper grades the designer can improve his product economically. As time clears up certain at present obscure points the uses of gray iron castings are quite likely to be extended rather than restricted. More science in the foundry plus conservative exploitation by gray iron interests will establish confidence in this valuable metal.

Is Series of Alloys

Much confusion has arisen because foundrymen and engineers seem to regard the term gray iron as specific rather than generic. Gray iron is a series of alloys, and within this series are found materials which vary widely in many of their important mechanical properties. Many specifications read soft, machinable cast iron, or tough, close-grained metal, etc. Cast iron was spoken of as a rigid metal, whereas it is not rigid when compared to certain other metals. It was called corrosion resistant, whereas it is mildly corrosion resistant under a limited number of conditions only. Foundrymen spoke of the strength of an arbitration bar whose test results do not have direct engineering significance.

Cast irons were said to grow in a certain mysterious fashion when subjected to moderately elevated temperature—some grades will, whereas others perform quite respectably at temperatures several hundred degrees higher. The foundrymen gave great attention to the elements silicon, manganese, phosphorus and sulphur and neglected one of the most important variables, total carbon content. Sulphur was the bugbear of the foundry until a few careful researches demonstrated that metal could be made quite successfully with this element almost twice the percentage formerly considered good practice. Oxygen content does not mean much according to bureau of standards findings. Little really reliable information was available to the engineer. Too little is available today. However, there have been some advancements in and correlations of our knowledge which are worthy of serious consideration.

Useful properties of an engineering material depend in large degree to its resistance to application of various forms of energy. For example its resistance to fracture when resisting mechanical stress, and the relative strain it undergoes under similar application of mechanical forces find expression in the terms ultimate strength and modulus of elasticity. Its freedom from constitutional changes and chemical deterioration under subjection to

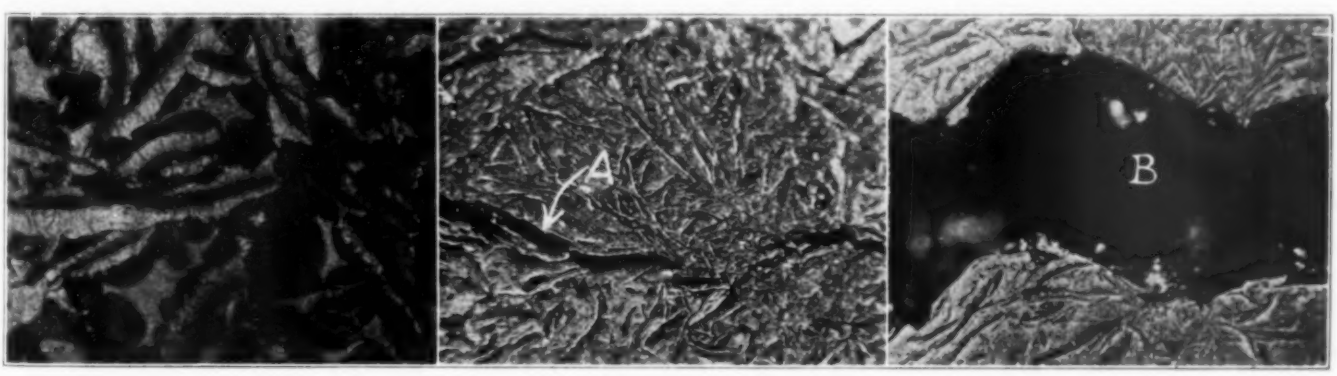


FIG. 12—STRUCTURE OF SOFT OPEN GRAY IRON SHOWING GRAPHITE, FERRITE AND PEARLITE. FIG. 13—SHOWING FRACTURE JUST STARTED AT *A*, 10 DIAMETERS. FIG. 14—APPEARANCE OF THE FRACTURE AFTER IT HAS OPENED UP, IS SHOWN AT *B*, 15 DIAMETERS

elevated temperatures represent various types of resistance to heat effects. In a like manner its reaction to conduction of electrical current is a measure of one of its reactions toward electrical energy.

Unfortunately, it is not possible to test out in a direct and simple fashion the effect of application of the apparently most simple forms of energy—for as a rule several forms are working at the same time in the usual conventional tests. All tests, even the simplest are complex when analyzed—they do not measure any one property. Also any grade of gray cast iron is itself an intricate alloy. Its structure is one of the most complex with which the metallurgist must deal. So, while always trying to get down to simple fundamental things, most of our knowledge must remain empirical.

Any grade of gray iron is microscopically heterogeneous alloy. As in case of any metal, its physical and mechanical properties depend on its structure. Gray iron is composed of various amounts and arrangements of four components, namely, graphite, pearlite, ferrite and steadite. Graphitic carbon is nontenacious, weak, nonductile and soft. Fig. 3 is a micrograph showing graphite flakes (black) in a white background. The sample merely was polished. Pearlite, the characteristic thumb-print structure, is shown in Fig. 4. It is composed of alternate lamellae of ferrite and cementite (iron carbide). It is an eutectoid, that is to say, these components are present in constant ratio under normal conditions and it is formed at a definite temperature. Pearlite is strong. Sauveur gives 70,000 pounds per square inch as the tensile strength of the lamellae form and 110,000 pounds per square inch for normal pearlite. It has a brinell hardness about 200. Pearlite (itself) usually contains about 0.85 per cent combined carbon, and is formed at about 1340 degrees Fahr. in gray iron. This is shown by the inverse rate cooling curve, Fig. 2.

These curves are used to determine the critical temperature at which certain reactions take place in the solidifying metal. When a decided change takes place in the structure of the metal, it always is accompanied by a change in internal energy content usually discerned through the evolution or absorption of heat. This changes the regular cooling rate and by plotting the energy changes inversely, these changes are depicted as sharp jogs in the curve. In the case illustrated in Fig. 2, three important changes are shown.

Ferrite is the structural form assumed by pure iron and some of its solid solutions. This structure (plus some graphite) is shown in Fig. 5. The ferrite of ordinary gray iron contains some silicon and a small percentage of dissolved carbon. Its brinell is about 100. The phosphorus in gray iron is found in the formation known as steadite and shown in Figs. 6 and 7. In the higher phosphorus irons (above 0.50 per cent) this formation generally consists of a binary eutectic of iron and phosphorus containing 10.2 per cent phosphorus and 89.8 per cent iron. In lower phosphorus iron the steadite apparently contains less phosphorus, and does not assume as much of the characteristic honeycomb or cellular eutectic structure. As shown in Fig. 2, the steadite forms around 1800 degrees Fahr., considerably under the solidification point of the remainder of the metal. For this reason it imparts some fluidity to the alloy and usually is found at the grain boundaries. Steadite is hard and brittle.

In addition to the four major structural components mentioned, sulphide and silicate inclusions are found in small amounts as shown in Figs. 8, 9 and 10. Irons cooled too rapidly may show a white or mottled fracture as indicated in Fig. 11. These chilled irons are not strictly true gray irons.

The general structure of a soft, open-grain, gray iron is shown in Fig. 12. The wormlike flakes are graphite, the white areas with threadlike grain boundaries ferrite, the gray areas pearlite, and the semidendritic white formations in the pearlite are steadite. This outline of the structure of gray iron is brief and those interested further are urged to study the various papers which have appeared in THE FOUNDRY and other technical publications and the *Transactions* of the American Foundrymen's association. The engineer should remember that the properties of the various structures as outlined are transmitted to the alloys in which they occur. Thus an iron largely graphite and ferrite would be weak and soft, whereas an iron high in phosphorus would be hard and brittle, etc.

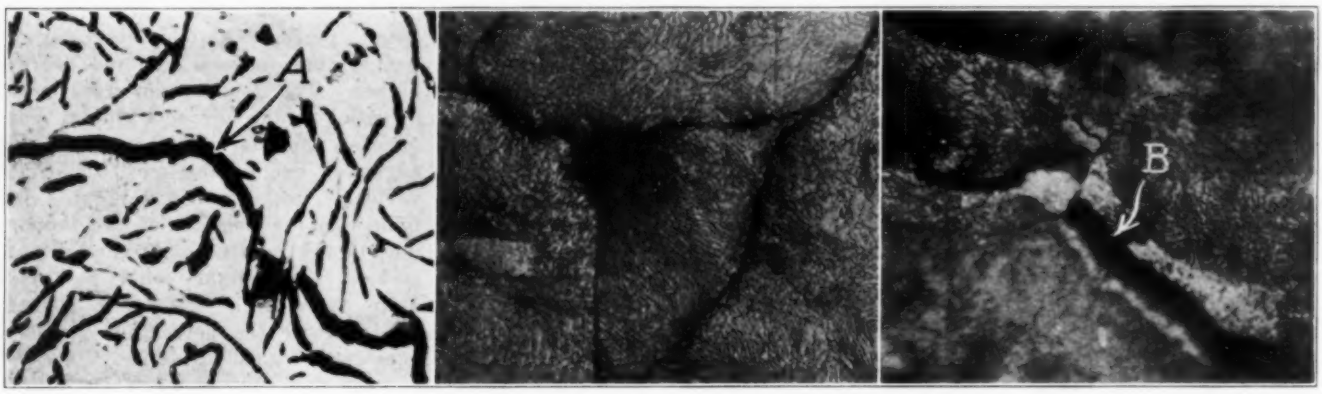


FIG. 15—FINE FRACTURE THROUGH GRAY IRON MAGNIFIED 50 DIAMETERS IS SHOWN AT *A*. FIG. 16—FRACTURE JUST STARTED IN PEARLITE ETCHED WITH PICRIC ACID, 500 DIAMETERS. FIG. 17—FRACTURE PASSING THROUGH STEADITE IS DESIGNATED *B*. ETCHED WITH PICRIC ACID, 500 DIAMETERS

Planes of fracture through a piece of metal tend to follow the paths of least resistance. In gray iron this normally would be along the weak graphite flakes. That this is the case is shown in Figs. 13, 14 and 15. The black jagged band is the fracture opening. Looking along the edges of this fracture the line may be observed as proceeding along the graphite flakes. In these micrographs, made with the Silverman illuminator the graphite flakes appear as lighter colored depressions in a darker gray background. In a micrograph with the usual illumination the flakes appear black against a white background.

Since the graphite flake structure is not continuous the fracture must proceed through the intervening pearlite, ferrite and steadite. Lines of fracture through the pearlite are shown in Fig. 16. If the steadite (phosphorus formation) were much stronger than the pearlite the fracture would pass around the steadite crystals. That this is not the case is

(*Concluded on Page* 142)

Let Apprentices SELL Apprenticeship

By C. J. FREUND

Part II

Apprentices Were Working in Every Department

THE employment manager of the Cunningham Foundry Co. telephoned to the works manager one morning and asked when he could see him for a few minutes. The works manager suggested that he come right away.

Apprentice training had become well established in the plant. There were apprentices in every important department. The different foremen had developed methods for handling them and worked with them successfully. The total number of apprentices had grown to more than a dozen and they were the most spirited single group in the shop and supplied buoyancy and good spirits to the entire personnel.

One or two were already well along in their third year and surprised everyone by their ability in getting out rather difficult work.

As a result, there was a demand for more apprentices in the shop and as the organization was large and employed many hundreds of men, many more apprentices could be engaged without becoming a burden. The employment manager was having his difficulty in getting in touch with the right kind of applicants. Naturally, he desired to engage only boys of the highest class and only those who were genuinely interested in foundry training and were not merely looking for a job. His purpose in conferring with the works manager was to find out what ideas the works manager could give him for the solution of his problem. He found the works manager quite elated over the success of the apprentice training work and after some general talk on the subject he introduced his problem.

"There is one side to this apprentice business which is not so favorable," he began. "It is not easy to get the right kind of boys into the shop. They want more apprentices in most of the departments and I am hardly able to supply them. Sometimes it appears to me as if every desirable boy in the city were already working here. Right now they want three more and although I've been in touch with all the regular employment sources, and a few others, I have not been able to engage the kind of young men we want.

Have Wrong Idea

"There is nothing attractive on the surface of foundry work; it is not like aviation or radio or auto-mechanics. People still think the foundry is a dark, hot place where men spend most of their time carrying heavy ladles. They don't realize that we are carrying on an educational enterprise. I think we ought to go out and deliberately peddle this thing in the community."

The works manager smiled a little as if he didn't take it all so seriously. Then he thought a moment and said,

"I think it is a good plan to give apprentice training publicity but at the same time I feel that our apprentice work has been developed to such a point that the apprentices themselves will sell the idea to the community, just as they have sold it in the shop. Brothers, neighbors, classmates and cousins will observe the favorable results of apprenticeship and will soon apply for training. Before long each apprentice will become the center of a rapidly growing influence in favor of apprenticeship."

The employment manager was not fully convinced but he returned to his office after a long discussion, feeling that the works manager fully understood the reasons for his failure to find the number of apprentices the department heads requested.

He hardly had reached his desk when he had a telephone call from a Y. M. C. A. secretary who wanted to send out two young men to apply for apprentice training. This was a great relief to the employment manager and also something of a surprise because his attempts to hire apprentices through the Y. M. C. A. had been futile for some weeks past. He asked the secretary the reason for the change.

"Well," the secretary answered, "Our boys have a new attitude toward foundry apprenticeship which has been brought about largely by Harrigan and Spehl, two of your apprentices who live here. You appreciate that the majority of the young men who live here are still floundering around considerably. They have no trade and but little experience and are still feeling their way in the world. Boys of this type are, of course, at the mercy of business conditions and are frequently out of work. Many of them seldom hold a job longer than a month and constantly are in danger of becoming se-

rious problems as they hardly earn enough to make a living.

"During the last week or so it has become known around here that Harrigan and Spehl have worked in the same place for over three years and their interest and enthusiasm in their work have convinced the others that this work is desirable. Some of the boys have asked them about the apprenticeship arrangement and the idea of a contract which assures trade training in addition to steady work appeals to them very much."

"But their pay is much less than the boys receive on other jobs," the employment manager said in answer.

"By the hour, yes. But in the course of a year the apprentices have earned as much as the others because the apprentices have work steadily while the others have not."

When the employment manager had hung up the receiver he muttered to himself that perhaps the works manager was not so far wrong after all and prepared to receive the applicants who were on their way out from the "Y."

A Molder's Son Applies

The regular noon meeting of the foremen was in session and they were discussing apprenticeship as they often did now.

"One thing about this apprenticeship business doesn't seem right to me," Perkins was saying. "None of the molders' boys ever come in to be apprentices. The plan seems to be working out but there must be something about it that keeps the men from bringing their boys in. As far as I know, none of the molders' boys have ever asked to be taken on."

"Well, our men are careful about trying out things," suggested Dietrich. "It's natural for them to be a little bit against anything the company starts. At first they fought the new machinery which made their work easier though they like it now. They say it was the same way with compressed air and rammers and cranes when they first came out. It's the same with apprenticeship. When the men have seen it work long enough they will send their boys in; only, they need a lot more convincing than we do."

"I don't believe it," said Larson who had a tendency to be pessimistic. "All the boys want to be doctors and bankers and lawyers. I'll bet two dollars that none of our molders' boys will come in for apprentice work in the next half year."

"I'll take you up on that," the employment manager said so quickly that Larson lost most of his assurance. He had not expected that anyone would so emphatically disagree with him. However, he reluctantly made the bet.

Nearly five months had passed when the employment manager one afternoon telephoned to Larson to come down to his office. When he arrived there he found Jake Parker, one of the molders on the heavy work, and with him a big, bright looking lad, obviously his son for he had the same nose, eyes and chin.

"Here you are," the employment manager said to Larson as he came in. Then he turned to Parker. "Your coming here will cost Mr. Larson two dollars," he said gleefully.

High School Graduates Became Apprentices

"Why?" Parker asked.

"Mr. Larson bet me that no son of any of our molders would apply for apprenticeship before the end of next month."

"He would have lost anyhow if I hadn't come because Bert Hall, Charley Spencer and Harry Berg are all coming in next week or the week after."

"Just why did you bring the boy in?" asked Larson, more interested in Parker's motives than in the two dollars.

"We have been watching these apprentices and they're getting pretty much what I wanted to get when I was a youngster. I always thought I wanted to learn something about the theoretical part of the foundry business in some kind of a course but there wasn't any such thing and I couldn't afford to quit work to go to school so I just had to pick up what I could while I was working. This apprentice thing just about fills the bill. Our family has always been molders; my father was in the business and so are my brothers. And now that my boy is getting started he might just as well do it up right."

"You win," said Larson to the employment manager and there was much kidding next noon when the money was paid.

"The big boss has some good ideas on apprenticeship that you fellows ought to learn about," the employment manager remarked as he complacently put the money away.

Before engaging an apprentice the employment manager always took measures to satisfy himself that the applicant fully understood the step he wanted to take.

A young man came into the employment office one day and confidently announced his desire of becoming an apprentice.

"What do you know about apprenticeship?" the employment manager asked him.

"Nothing except that it's a way to learn a business," the young man replied.

"Did nobody ever tell you about a contract?"

Questions the Applicant

"What contract?" the boy asked and the employment manager knew there was no use continuing in that direction.

"What do you know about the foundry?" he asked again.

"Not much."

"Do you know what kind of work is done in a foundry?"

"They make iron, I guess."

"How is iron made?" continued the employment manager smiling.

"I don't know."

"Then why are you so sure you want to work at making it?"

"It isn't that I'm sure of, what I'm sure of is that I want to work in this shop."

"Why?" asked the employment manager, very much interested.

"Because the apprentices here are a swell bunch of fellows and I want to be one of them. I played basketball against the apprentice team from this factory last month and they not only gave us a trimming but they made us enjoy the game. It was the cleanest game I ever played in. They were swell fellows all around. Everybody liked them and all the girls said they were awfully nice.

"A couple months ago the apprentices from here gave a dance and it was as good a party as any high school ever puts on. I asked one of the fellows how they could have such a good time without raising the dickens and he said they all agreed they didn't want to disgrace their club.

"I figured this way. I haven't made up my mind what line of work to follow but I wouldn't make any mis-

take if I came in here because anything that keeps a swell bunch of fellows like this together must be all right."

"I wish my big boss could hear you talk," the employment manager remarked in a tone of satisfaction and surprise.

"Why?" asked the boy.

"Some day I'll tell you. In the meantime I appreciate your attitude but I would not advise you to take up any line of work without knowing something about it. Come in tomorrow afternoon and we'll take a walk through the shop and I'll explain the work to you. Then I'll give you a booklet to take home and read and if you're still interested two weeks from now I shall put you on."

The young man began work as an apprentice less than three weeks later.

The High School Student

In carrying out his plan for giving apprentice training as much publicity as possible, the employment manager had become something of a public speaker. He had discussed apprenticeship before Rotary, Kiwanis and other service clubs, before women's clubs, the press association, parent-teacher associations of primary schools, before meetings of Y. M. C. A. clubs and a number of lodges and similar organizations.

Although he desired to maintain a certain proportion of high school graduates among the apprentices he had never been invited to speak before a high school group and had never sought to do so because he feared he would not be welcome.

Accordingly, he was much surprised early in May when the principal of the Webster high school telephoned to him and asked him to discuss the foundry business and foundry apprenticeship before an assembly of senior boys on the following Friday afternoon.

When he arrived at the school he was impressed by the magnificent entrance and vast corridors and he instinctively felt that a certain gap must necessarily tend to arise between these refined surroundings and apparent rough and tumble of the foundry. He was conducted to the principal's office and was cordially received by him and his assistant.

"Isn't it a bit unusual for a man from industry to be invited to speak to a group of seniors on vocational subjects?" the employment manager asked. "Frankly, I was of the opinion that school officials were interested primarily in getting as large a proportion of their senior class into college as possible and that they disliked exposing them to any influence which might thwart this purpose. For this reason I did not think that you were especially interested in apprenticeship."

The principal smiled.

"That is the traditional attitude of the high school principal," he explained. "We have changed our policy here in the last year or two. We have found that in spite of our efforts only a minority of our graduates ever attend college. We have neglected the majority for the minority. We feel that it is time for us to point out to the majority who cannot attend college the opportunities for work which exist in the community. We believe that the majority who must go to work need more assistance and guidance than the minority who will attend college. It is now our opinion that the minority who are destined to attend college cannot easily be turned from their purpose by any influence or combination of influences.

Boys Interested in Foundry Training Were Wanted

"Of course, we are careful about the kind of work we recommend to our graduates. We invite speakers only from those business institutions in which we know, from careful investigation, that young men are not merely given employment but are provided facilities for developing themselves and building a career.

"Two years ago a number of graduates of our school became apprentices in your shop without our knowing about it. Undoubtedly you know who they are. They have visited the school frequently and have made a deep impression by their enthusiasm for their work which, we understand, is somewhat difficult to make attractive. Apparently you have made it so. But the feature of your system which seems to us the most important is that you carry on the training of the young men and maintain in them those high ideals of character and citizenship which we have attempted to instill during their school years.

"Upon further investigation of your organization, we decided to invite you to speak to our seniors about your work and we are prepared to recommend the foundry industry to our graduates."

Ten minutes later 150 senior boys were assembled in the auditorium of the school and he explained the foundry business to them, granted its disadvantages, pointed out its advantages and described graphically the system of apprentice training. Five or six expressed an interest in the work and asked him many questions and two months later three of them became apprentices.

"Our neighbor's son told me about your talk at the high school yesterday afternoon," the works manager said to the employment manager the following morning. "I told you that the community would favor our training work after a time but I did not think that the high schools would become interested for many years."

Parents Bring Their Sons

The works manager had just opened the formal Wednesday noon foremen's meeting.

"In answer to a number of questions asked in the meeting last week regarding the growth of the prestige of our apprentice work in the community and particularly regarding the type of people who have come under its influence, I have asked the employment manager to bring today the application blanks of a number of apprentices who have been put on in the last few months. They contain interesting information."

The employment manager produced a number of apprentice records from which he read in turn.

"Here is an apprentice who was brought in by his father who is a druggist. The boy was not interested in college nor in his father's business but wanted to do mechanical work. The father did not wish the boy to learn anything by drifting around from one job to another as he believed in systematic ways of doing things. Therefore, he brought him here for systematic training.

"Here is another who was sent in to us by his mother, a widow. The father had been a bricklayer. It was necessary that the boy should have steady work and both he and the mother felt the need of trade training. After going over the various opportunities provided in the city, they

selected foundry training in our shop and made application.

"This boy is a son of a molder and wanted to learn the foundry business but thought he could learn it by doing all kinds of foundry work at random in whatever shops he might find himself for he was afflicted with wanderlust. The father brought the boy to us much against his will at first but he can see now the wisdom of the apprenticeship arrangement.

"Another one of our apprentices—you probably all know whom I mean—is the son of a prominent local attorney. The boy wants to become a metallurgist and to take a course at some university. The father believes that the boy should have practical experience to determine whether or not he likes the atmosphere before he undertakes a full college course.

"The father of another apprentice didn't know what the boy would like for his life work but sent him down to us to investigate our plan because he liked the idea of regular advancement and promotion, like in a school.

"I could go on and tell the story of each one of our apprentices and I believe that in the majority of cases they are with us as the result of a favorable impression made upon some mature member of the family by the systematic training work we have undertaken."

"Of course," the works manager added, "The fact that a boy's parents bring him when he applies for apprenticeship is not an infallible indication of the boy's success in his work but it does indicate that the parents will encourage him in his efforts and especially that our apprenticeship system is recognized by thinking people in the community."

The works manager and the employment manager left the meeting room together after the conference was over.

"If this keeps on," the works manager remarked, "We shall soon have a waiting list for our apprenticeship."

"Soon," replied the employment manager enthusiastically, "Soon, why there are a dozen fine young men on the waiting list right now."

Plan Program for Joint Meeting

PLANS for the regional meeting being sponsored jointly by the American Foundrymen's association and the Quad City Foundrymen's association have been completed. As previously announced, this first regional meeting ever held by the American Foundrymen's association and a district foundry association will take place at Moline, Ill., on Wednesday, March 26, with foundrymen from many states in attendance.

The morning will be devoted to visiting plants of the surrounding district. As the region includes a number of important gray iron, steel and malleable foundries, a large number of visitors are expected to make these inspection trips.

At 12:15 p.m., six different round-table luncheon sessions will be held, covering steel founding, nonferrous practice, malleable founding, cupola practice, gating and risering, and foundry costs. The following prominent foundrymen will lead the discussion at each of the sessions:

Steel Founding—Chairman, L. S. Peregoy, Sivyer Steel Casting Co., Milwaukee.

Nonferrous Practice—Chairman, R. R. Monroe, Des Moines Foundry & Machine Co., Des Moines, Ia.

Malleable Founding—Chairman, P. C. DeBruyne, Moline Malleable Iron Co., St. Charles, Ill.

Cupola Practice—Chairman F. B. Coyle, International Nickel Co., New York.

Gating and Risering—Chairman, E. W. Smith, Crane Co., Chicago.

Foundry Costs—Chairman, A. J. Tuscany, Gray Iron institute, Cleveland.

At the technical session which will convene at 3:00 p.m. at which time two interesting papers will be presented, R. F. Harrington, Hunt-Spiller Mfg. Corp., Boston, and chairman of the American Foundrymen's association subcommittee on foundry sand reclamation, will speak on "Foundry Sand Control" and E. W. Page, Victor X-Ray Corp., Chicago, will discuss problems in the "X-Ray Examination of Castings."

S. W. Utley, Detroit Steel Casting Co., Detroit, a director and past-president of the American Foundrymen's association, will be the speaker of the evening at the banquet, scheduled for 6:30 p.m., according to J. H. Ploehn, French & Hecht Inc., Davenport, Ia., chairman of the committee on reception and arrangements for the regional meeting. A. E. Hageboeck, Frank Foundries Corp., Moline, Ill., is in charge of the round-table discussions, while H. Bornstein, Deere & Co., Moline, is arranging the technical session and J. D. Diedrich, Blackhawk Foundry & Machine Co., Davenport, the plant visitations program.

Institute of Metals Will Meet

The twenty-second annual meeting of the British Institute of Metals will be held at the Institution of Mechanical Engineers, London, March 12 and 13. At the opening session on March 12, the new president, Dr. R. Seligman, will read his presidential address.

The following papers will be presented at the meeting: "Experiments on the Influence of Gases on the Soundness of Copper Ingots," by N. P. Allen; "Unsoundness in Bronze Castings," by E. J. Daniels; "Gases in Copper and Their Removal," by W. E. Prytherch; "Protective Value of Some Electro-Deposited Coatings," by L. Davies and L. Wright; "The Diffusion of Zinc in Copper Crystals," by C. F. Elam; "Microstructure of Cast Alloys. Effect of Turbulence Due to Gases," by R. Genders; "The Aluminum-Brasses," by R. Genders; "Atmospheric Action in Relation to Fatigue in Lead," by B. P. Haigh and B. Jones; "Investigation of the Effects of Impurities in Copper—Part VI—The Effect of Phosphorus in Copper," by D. Hanson, S. L. Archbutt, and Grace W. Ford; "A Note on Metallic Magnesium," by W. R. D. Jones; "A Note on Zinc-Base Die-Casting Alloys," by R. Lancaster and J. G. Berry; "The Early Use of the Metals," by T. A. Rickard; "The Composition of Eutectics," by D. Stockdale.

The annual dinner of the institute will be held March 12, at the Hotel Victoria, London, and will be followed by a dance. The annual May lecture will be given May 7, by Maj. F. A. Freeth, joint research manager, Imperial Chemical Industries Ltd. The autumn meeting of the institute will be held in Southampton, Sept. 9 to 12.

Tests Street Signs

The District of Columbia has made a study of cast iron street designation signs. They were tested for material, color combinations, elevation and direction. As a result of night tests for visibility, gold embossed letters on a black field were adopted.

Fig. 1—View of One of the Molding Lines Showing the Making of the Drags, the Conveyor System for the Cores at the Left, and the Setting of Cores

Specializes in Automotive Castings

By Edwin Bremer

ECONOMICAL production of gray iron castings in large foundries, particularly those engaged in automotive work, is due in a large measure to an intensive study of methods to conserve manpower. Results have been accomplished by eliminating unnecessary labor and centralizing operations. This was shown in an article describing the new continuous core oven employed by the Lakey Foundry & Machine Co., Muskegon, Mich., which appeared in the Feb. 15 issue of THE FOUNDRY. While that article related only to the core department, the same principles are employed in the foundry of that firm, and a description of the essential features of the cylinder foundry will be of general interest.

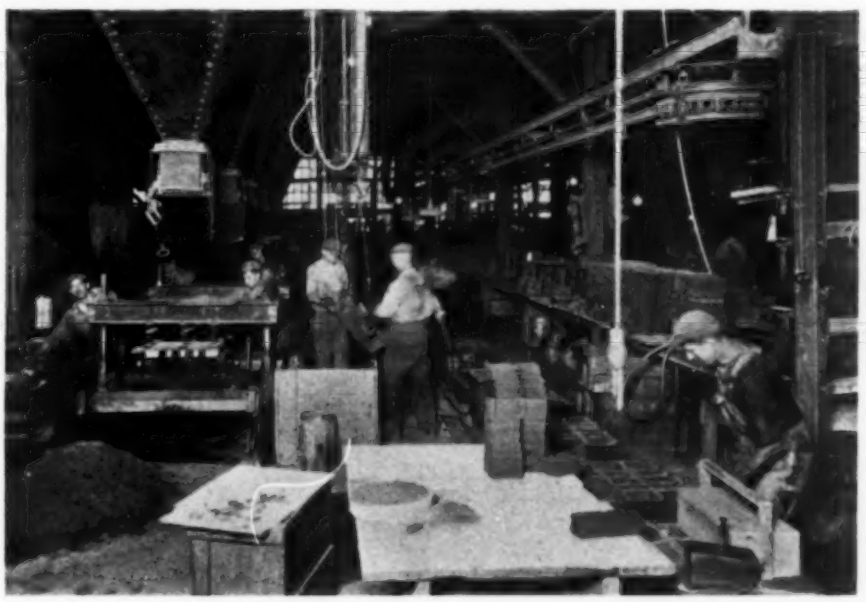
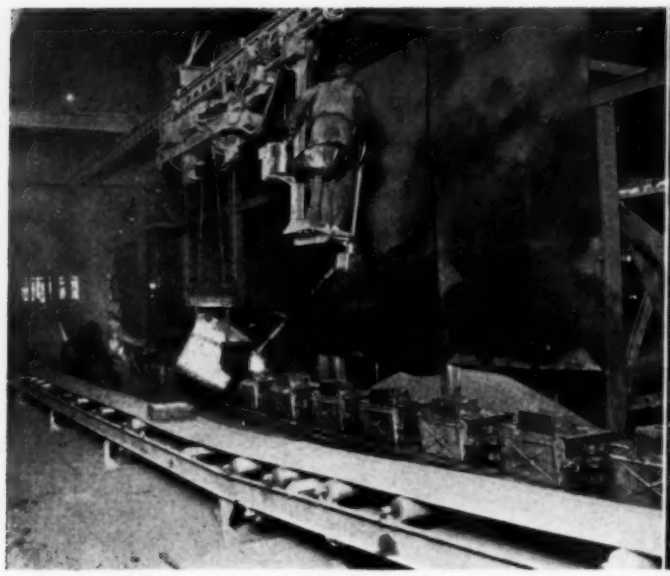


Fig. 2—After the Cores Are Set, the Copes Are Placed in Position and Clamped. The Man at the Right Makes the Runner Basin Containing the Strainer Core and Puts On the Backing Plate

Briefly, the drag half of the mold is made and placed upon a conveyor which carries it to the core setters who put the cores in position, using gages to check the accuracy of placement. The cope half of the mold then is lowered into position, and the two parts of the mold are clamped together to prevent shifting. The finished mold is moved along slowly to the pouring station where it is filled with molten metal. The molten metal is conveyed in ladles suspended from electrically-driven hoists which travel on a monorail system. This method of trans-



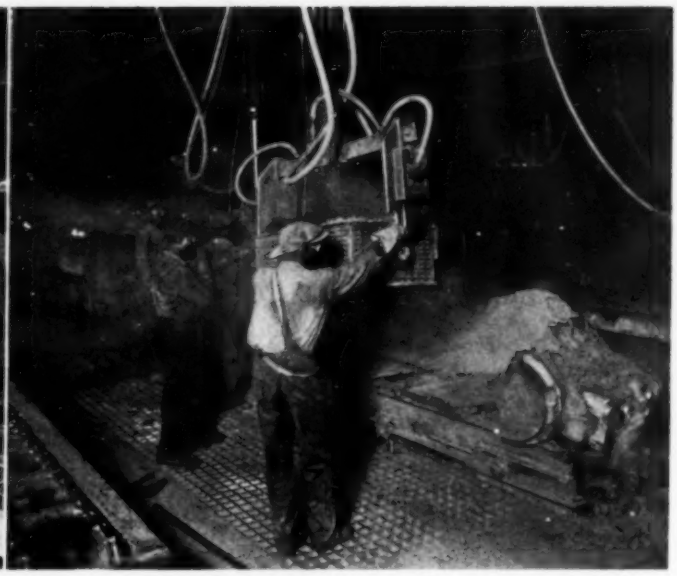


Fig. 3—Molds Are Poured in Motion from a Ladle Suspended from an Electrically Driven Hoist. Fig. 4—End of a Conveyor Line Showing Method of Shaking Out Molds

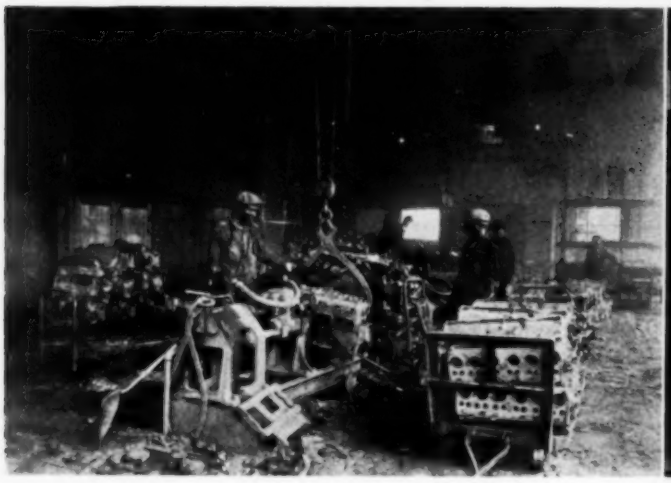
portation allows the mold to be poured while traveling on the conveyor.

The mold then is carried to the end of the conveyor system where the casting is shaken from the mold. The sand drops through a grating in the floor and is returned to the molding system after proper reconditioning. The castings are piled on a truck and transported outside to cool. Later it is carried to the opposite end of the foundry where the core knock-out department is located. Cores are removed by special machines employing the vibratory principle. After the cores are knocked out, the castings again are piled on trucks and carried to the cleaning department.

Cylinder block cleaning involves several operations which include cleaning in a tumbling barrel, chipping and grinding, sandblasting, and a final inspection to see that all internal core wires are removed. The castings are taken from the tumbling barrels and placed on roller conveyors a short distance away, on which the cylinder blocks are carried to the grinders. These are the swing type and are used to remove any fins or projections on top part of the block. The castings then are moved on roller conveyors to the chipping benches which are situated inside the ring of swing grinders. At the chipping benches all projections and rough spots inaccessible to the swing grinders are removed as are the core wires and the castings then are conveyed to the sandblast.

Cylinder blocks are sandblasted in a double, continuous type sandblast room. The roller conveyors lead up to the sandblast room, and the castings are carried on through by a traveling chain. From the sandblast the castings are moved on roller con-

Fig. 7—Sand Is Reconditioned in Sand Mixers



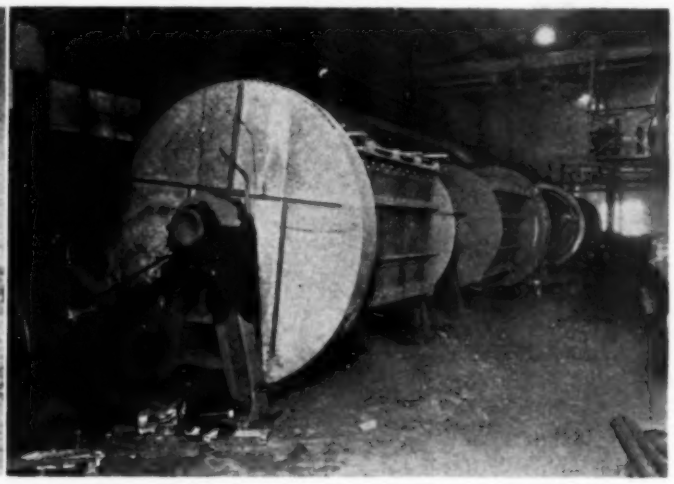


Fig. 5—Vibratory Core Knockout Machines Rapidly Disintegrate the Cores Which Fall from the Castings. Fig. 6—A Partial View of the 14 Tumbling Mills

veyors to the final cleaning inspection where examination is made to see that all core wires are removed and that the casting is cleaned properly. After this operation the castings are tested for leakage under water pressure. From the water test the castings are sent to the final inspection where the castings are gaged for accuracy of dimensions. Following this, the castings are forwarded to the painting department and then to the shipping department.

While this rapid survey of the various operations may give the impression of rather jerky and haphazard movement of raw materials, semifinished and finished products through the plant, the ease, smoothness and rapidity with which the actual work is accomplished is surprising. Five molding lines are used in the foundry of the Lakey company. Two of the conveyors are the apron type supplied by the Link-Belt Co., Chicago, and shown in Figs. 1 and 2. Two of the remaining three are chain type conveyors and the third is a gravity roller type conveyor. The chain type conveyor consists of two parallel chains on either side of the supporting framework which project sufficiently to engage the bottom board of the mold and carry it along. Rollers spaced on short centers support the chain between the sprockets at either end of the conveyor. Views of the chain conveyors are shown in Figs. 4 and 7.

Cylinder blocks are molded on two machines supplied by Wm. H. Nicholls Co. Inc., Richmond Hills, Long Island, N. Y.; six machines manufactured by the Stoney Foundry Engineering & Equipment Co., Cleveland, and 12 machines made by the Osborn Mfg. Co., Cleveland. Each molding line employs four machines; two being devoted to making of drags and the remaining two are used in making the copes. The molding machines are jolt-squeeze, pattern-draw type and are arranged in a single line parallel to the mold conveyor. As may be observed in Figs. 1 and 2, an aisle or gangway approximately 6 feet wide is located between the machines and the conveyor. Flasks used for the molds are cast steel especially designed for the purpose by the engineering department of the Lakey company. The flasks contain supporting bars placed at right angles to the sides which vary in depth to conform to the general shape of the pattern on the joint side of the flask.

Fig. 9—Castings Are Turned Over as They Pass from One Sandblast Room to the Next

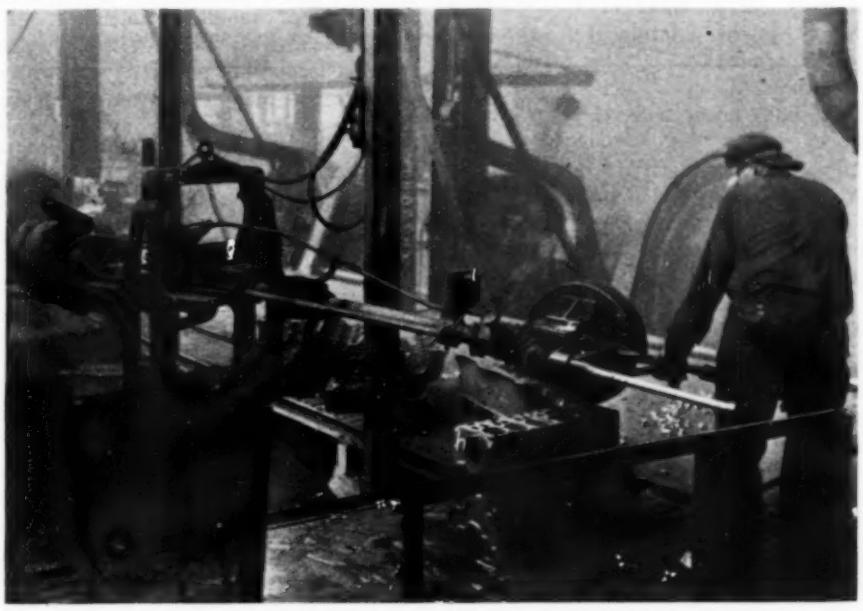


Fig. 8—Swing Grinders Remove Projections from the Castings

Flasks Have Open Side

One side of the flask is cut down to almost one half its depth as viewed from the joint side. When two halves of the mold are in position the opening formed allows the bottom edge of the crankcase part of the core to come flush with the side of the flask. A closely fitting, rectangular box-shaped plate filled with sand is

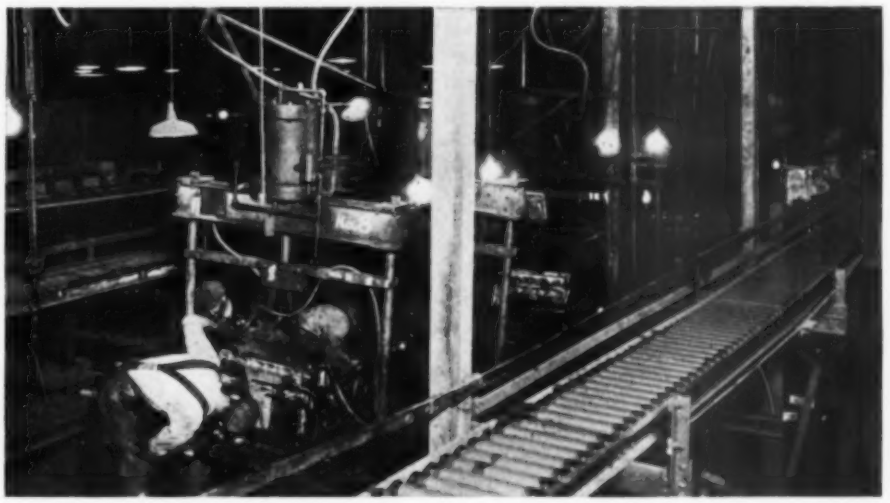


Fig. 10—Water Under Pressure Reveals any Leakage in the Water Jackets

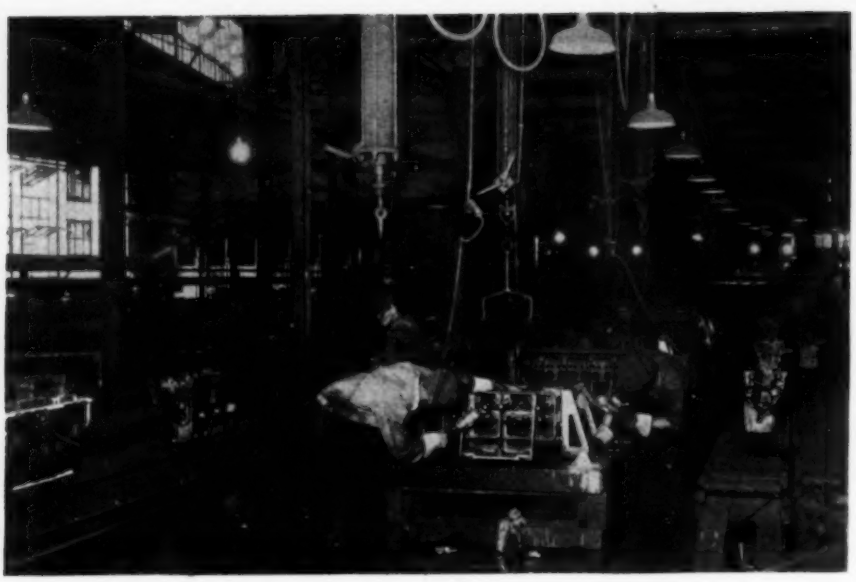


Fig. 11—Gaging the Castings for Accuracy of Alignment

used to cover the opening when the mold is poured. This plate slides into slotted brackets on the drag flask. Ample venting of the flask is provided by a large number of perforations in the other three sides. Trunnions on brackets allow the handling slings or hooks to be attached to the flasks without danger of the workmen getting their fingers pinched between the hook and the projecting ear containing the flask pin or hole. This method also allows the flask to be rotated in the hooks without striking the afore-mentioned ears.

In making the molds, a flask is placed on the platen of the molding machine. The gate of the storage hopper is opened by the operator long enough to allow a sufficient amount of sand to fall into the flask. The flask containing the sand then is jolted until the sand is of the required density. This operation necessitates some experimental work at first to determine the proper amount of jolting. However, once this is determined, molds may be turned out with regularity and dispatch. Following the jolting, the squeezer frame is swung into position and the sand is given additional compression through the projections on the squeezer board which are similar in shape to the openings between the bars in the flask.

Use Bottom Boards

After the mold is squeezed the air is released and the squeezer frame, which swings in a vertical arc, is pushed back out of the way and the pattern is drawn. An air hoist suspended from a short section of monorail then is placed over the machine and the rings of the chain sling slipped over the flask trunnions. The mold is raised clear of the machine and is pushed across the gangway to the conveyor. If the mold is the drag half, it is rolled over in the sling and lowered onto the bottom board which is composed of two short sections of heavy plank placed two or three inches apart. These pieces are slightly longer than the flasks. The same procedure takes place in the case of the cope mold except of course, that it is placed in the proper position on the drag.

As previously mentioned in the article presented in the Feb. 15 issue of THE FOUNDRY, the cores, after being inspected, are sent either directly to the molding lines or to the storage racks. Since the cored parts of a cylinder block are formed by several cores rather than one single core, a method had to be devised so that all cores would be delivered to the core setters in a regular sequence to prevent mixups and delays. The method used at the Lakey foundry employs aluminum grids about two feet square upon which one complete set of cores for a single cylinder block is placed. The cores placed on the grids are taken either from the conveyor lines leading from the core department or from the storage racks.

The grids containing the sets of cores are inspected carefully to see that none is missing, and then placed on a gravity roller conveyor on which they are moved parallel to the molding conveyor line to the core setters. The roller conveyor for the cores is elevated about 3 feet above the floor and is approximately 2 feet from the molding line to allow enough room for the core setters to work. Each molding line employs three core setters who place all cores for the two sets of molding machines. As the cores are placed, they are checked for accuracy of position with steel gages or templates. When the cores are removed, the grids are returned to the starting point of core distribution by an overhead conveyor system consisting of an endless chain with hooks. Fig. 1 includes one of the molding machines, the roller conveyor for the cores, shows the core setters and the method of returning the core grids.

Put on Backing Plate

After the cores are placed and gaged, the cope half of the mold is set on the drag and the two halves clamped together tightly. Then the backing plate which covers the exposed end of the crankcase part of the core, is filled with sand and

Fig. 12—Exhaust Hoods Remove the Fumes from the Spraying Operation

fitted into the slotted brackets on the drag flask which hold it in place. Molding sand is packed on the upper joint of the cope and plate to make a better seal. After the backing plate is in position, the runner box is prepared for ramming. A dry sand strainer gate made in two pieces is placed directly over the sprue opening in the mold. The larger of the two pieces is approximately 4 x 10 inches and contains four 1-inch holes arranged in the form of a square at one end. These holes open directly into the sprue. The second and smaller part of the strainer gate covers the four holes and is perforated with approximately thirty ¼-inch holes. A wooden block the size of the strainer gate is placed in the runner box and sand is rammed into the remaining space.

Fig. 3 shows the molds ready for pouring with the backing plate and the runner box in position. The illustration also shows the method of pouring. Metal is carried to the molds in 1-ton ladles suspended from an electrically-driven, open-cab type hoist traveling on a monorail. The operator of the hoist controls the lowering of the ladle and the tipping of ladle for pouring, and he is assisted by another man on the floor who inserts a long bar in one trunnion of the ladle to swing it slightly away from the molds. Each ladle holds enough metal to pour 15 cylinder blocks.

When the molds reach the end of the conveyor line they are shaken out as depicted in Fig. 4 with vibrating shakeout equipment supplied by the Stoney Foundry Engineering & Equipment Co., Cleveland. The cope is removed and the sand shaken out over a grating in the floor. The drag is rolled over so that the casting falls out on the end of the conveyor, and then the contained sand is shaken out as in the case of the cope. The casting is picked up and placed upon a nearby truck which when loaded is taken outside and the castings allowed to cool. Then they are taken to the core knockout for core removal.

Fig. 13—A View of the Wood Pattern Shop for Making Master Patterns

Sand shaken out from the flasks falls through the floor grating onto a conveyor belt of a sand handling system designed and installed by the National Engineering Co., Chicago, which carries it to the boot of an elevating conveyor and thence into a storage hopper. From the hopper uniform batches of sand are admitted to a sand mulling machine where a clay bond supplied by the Eastern Clay Products Co., Buffalo, is added. After a short period of mixing, sufficient water is added to provide the necessary moisture. The reconditioned sand is elevated to an overhead conveyor belt which carries the sand to the storage hoppers suspended above the molding machines. For the past two years no new sand has been added to the sand system; the bonding material being supplied by the clay.

Fig. 14—Metal Patterns Are Machined Carefully before Use

Is Well Ventilated

Castings from the shakeout are piled on trucks and taken outside to cool. The next day the trucks are transported to the core knockout department which is shown in Fig. 5. This department is located at the lower end of and outside the foundry proper. It is roofed over, but is open on two sides to provide plenty of ventilation as considerable dust is raised during the operation of knock-

Fig. 15—Patterns Are Gaged to See That They Meet Specifications

ing out the cores. Machines, supplied by the Stoney company and employing the vibratory principle, rapidly disintegrate the sand which falls through gratings under the machines. The gates are knocked off the castings and piled on a truck placed at the end of the machine.

After the cores have been removed, the castings are piled on another truck and forwarded to the cleaning department, which is shown partially in Figs. 6, 8 and 9. The castings first are tumbled in any one of 14 barrels supplied by the W. W. Sly Mfg. Co., Cleveland, and located along two walls of the room similar to those shown in Fig. 6. When removed from the barrel the castings are placed on a gravity roller conveyor system manufactured by the Mathews Conveyor Co., Ellwood City, Pa., which carries them first to the grinders and then to the chipping benches. Castings are ground with 8 swing grinders made by the Mummert-Dixon Co., Hanover, Pa. These grinders similar to the tumbling barrels are arranged in the form of the letter L and enclose the chipping benches.

Grinders Are on Pedestals

Fig. 8 shows one of the grinders in operation. As may be observed, the cylinder block is removed from the roller conveyor to flat steel plates forming the working floor so that the grinding may be done without any slipping or sliding. The swing grinders are used for rough grinding exterior portions of the blocks and are mounted on pedestals which permit the wheels to be turned in horizontal and vertical arcs. A rack and pinion permits backward and forward motion of the grinder. When the grinding is completed, the casting is pushed onto another gravity roller conveyor which carries it to the chipping benches which are enclosed on two sides by the grinders. The chippers remove all fins, rough spots, small projections, etc., which were not removed by the grinders. They also remove any remaining core wires and then forward the castings to the sandblasting department.

Castings are sandblasted in two continuous sandblast rooms designed and installed by the W. W. Sly Mfg. Co. The rooms, shown in Fig. 9, contain two entrances and are placed a short distance apart with the conveyors passing through both. Workmen between the two rooms turn the castings completely over as they pass from one room into the other so that they are sandblasted more evenly. The conveying line passing through the rooms is composed essentially of two parallel chains to which specially designed white iron plates are attached to form a type of apron conveyor.

After the castings are sandblasted, they are forwarded to the final cleaning line. Here the castings are inspected to see that the cylinder blocks are cleaned correctly and that all interior core wires, etc., have been removed. Then they are carried to the water testing department where under a water pressure of 60 pounds per square inch, the water jacketed section of the casting is tested for leakage. As may be observed in Fig. 10, water testing is accomplished by special clamping devices which admit water to only the jacketed part of the cylinder block. Examination of the exterior portions of the jacket instantly reveals any leakage or seepage of water through the casting walls.

From the water test the castings are forwarded to the final inspection department, part of which is shown in Fig. 11. Here the castings are checked for accuracy of alignment of the various openings, straightness of cylinder bore, parallelism of surfaces, etc. This work is done by placing the castings in prescribed positions on benches with heavy cast iron tops. These tops have machined surfaces on which the various gages or templates are mounted. Surfaces to be checked are painted with whiting and the gages placed in position. Sharp scriber points in various positions on the gage leave impressions on the whitened surfaces which indicate to the inspector whether or not the casting will meet the required specifications.

Has Complete Pattern Shop

Following the checking of the castings for accuracy, they are placed on a roller conveyor line which transports them to the painting department. While all castings pass through the department on this line, not all of them are painted. If such is the case, the operators of the spray equipment allow them to pass without painting. Castings to which paint is to be applied are sprayed with the desired color in exhaust hoods placed over the conveyor line, as shown in Fig. 12. Some of the castings are painted only on the inside and others are painted only on the outside according to the desire of the purchaser.

In addition to its cylinder block foundry the Lakey Foundry & Machine Co. maintains a completely equipped pattern shop which occupies a two-story building across the street from the foundry proper. Views of this department are shown in Figs. 13, 14 and 15. The wood pattern shop shown in Fig. 13 supplies the master wood patterns from which the active or shop metal patterns are made. Fig. 14 shows the metal pattern shop in which the metal patterns are finished to meet predetermined specifications, and Fig. 15 is the inspection and gaging department through which all shop patterns must pass before being put into use. The firm also operates another foundry located in a separate building where crankcases, fly wheels, cylinder heads, etc., are cast.

This is the second and concluding article describing the core room and cylinder foundry of the Lakey Foundry & Machine Co., Muskegon, Mich. The first article appeared on page 68 of the Feb. 15 issue.

British Institute Will Meet at Prague

The annual meeting of the British Iron and Steel institute will be held at Prague, Czechoslovakia, Sept. 15-20. The British society has received the invitation from the Society of Czechoslovakian Engineers and has accepted it. Ing. Sykora is president of the Czech society and Ing. J. Lubina is director and secretary.

The date for the opening meeting has been fixed for the week of Sept. 15. Sessions of the conference will be held in the new building of the Society of Czechoslovakian Engineers in Prague, which was completed during the past year. Visits will be made to several of the Czechoslovakian steel works and to many of the surrounding places of interest. A tentative program has been drawn up but the final arrangement has not been decided. One feature of the meeting will be a reception by the president of the republic. The date of this event has not been decided and will be arranged later. American visitors who wish to attend this meeting may secure the desired information from G. C. Lloyd, secretary, British Iron and Steel institute, 28 Victoria street, London, S. W. 1.

Drops Merger Plans

Negotiations for the consolidation of the Wheeling Mold & Foundry Co. with a number of other large iron and steel foundry companies have been suspended, following the expiration of options on majority of common stock held by Cochran, Scott & Co., Chicago banking firm. Failure to exercise the options was attributed to generally unsatisfactory financial conditions prevailing throughout the country.

French Foundry
Casts Silicon-Aluminum Alloy

By VINCENT DELPORT

IT IS curious that although the modified 13 per cent silicon-aluminum alloy was discovered by an American, the use of the alloy seems to have extended on the continent of Europe more than in the United States. In France and Germany especially, it is used in the form of castings for a wide range of manufactured products, including complete automobile chassis cast in one piece. There appears to be a considerable scope for the modified 13 per cent silicon alloy in the production of automobile parts, parts for airplanes, for diesel engines, and for railroad rolling stock in the form of doors, brackets and other fittings.

Treated With Alkaline Salts

Its properties are due to a special treatment with alkaline salts that takes place in the bath at a definite temperature and at a given time before pouring. The method of treatment is covered by various patents and in Europe castings made by the process are known alpax or silumin castings. The density of the alloy is 2.6, which is about 10 per cent less than ordinary aluminum alloys used for foundry work. It has only one-third of the density of steel. This property makes it particularly useful in aircraft construction. The alloy presents about the same resistance to corrosion by atmospheric agents as pure aluminum. It is claimed that it is less likely to corrode than many aluminum foundry alloys. It also resists the action of many chemical agents. One property that makes the modified 13 per cent alloy suitable for casting cylinder blocks and heads is its water-tightness. This same property exists with regard to gasoline.

Contraction of the alloy is about the same as cast iron and is substantially less than that of ordinary aluminum alloys. Its contraction is said to be the same for heavy and light sectional castings. In addition, the modified alloy is not tender during the period of solidification. These properties enable it to be used for castings of large dimensions and complicated design with comparatively little rejection due to cracks. It also is possible to cast inserts of other metals in the castings without creating flaws or internal tension. This feature is employed in casting bronze bearing parts in the journals of rear axles for heavy automobiles. The minimum tensile strength of the modified 13 per cent silicon-aluminum castings is said to be 27,000 pounds per square inch, with an elongation over 5 per cent.

Is Ancient Establishment

One of the principal firms engaged in making castings from the alloy on the continent of Europe is the Fonderies et Forges de Crans, with plants at Cran-Gevrier and at Lyon, France. The original plant is located at Cran-Gevrier, Haute-Savoie, near the lake of Annecy in the region of the Alps. It is more than 100 years old. Under Napoleon it was engaged in the manufacture of arms. In 1816 the province of Savoie came under the ruling of the king of Sardinia. At that time the plant was used for the manufacture of charcoal pig iron, iron castings, puddled iron, and the rolling of bars, sheets and tinplate, and the king authorized the works to be designated as a royal manufacturer. In 1848 puddling operations were accomplished exclusively with the use of blast furnace gas as fuel. In 1860 the province of Savoie was annexed to France. Consequently the Crane works was severed from its old trade channels and was confronted with keen competition from the French plants. From that time until 1905 the plant continued to operate under varying conditions and fortunes.

Made Stoves and Stove Parts

The present company was formed in 1890. At that time the plant was specializing in the manufacture of stoves and stove parts, drums used as calcium carbide containers, and similar products. In 1906 the concern entered the aluminum industry. A special aluminum foundry was opened up at Cran-Gevrier, which rapidly became prosperous. In 1909 the plant was equipped for the manufacture of aluminum sheets. This line developed to such an extent that the rolling of steel bars was abandoned in 1914 and the rolling of steel sheets also was dropped in 1918. In 1920 the expansion of the works was such that it was found necessary to build an entirely new plant at Lyon, where the aluminum foundry was transferred. Thus, at present the concern operates two distinct plants. The one at Cran-Gevrier specializes in the manufacture of aluminum sheets and bands. Its output capacity is about 2500 tons of rolled products annually.

Lyon was chosen as the location of the new foundry in 1920, because this city, which is one of the three largest in France, is the center of an important industrial district which constitutes a good outlet for the type of castings made by the company. The foundry was enlarged and modernized in 1926 and 1927. It is equipped to produce aluminum alloy castings in sand and in chill molds. The daily output ranges from 1.5 to 2 tons of finished products, and the number of men and salaried employes is about 250.

Foundry Has Three Bays

The foundry shop is divided into three bays. In the first bay modified 13 per cent silicon-aluminum alloy castings are made in sand molds. In the second and part of the third bay other aluminum-alloy sand castings are made, and the rest of the third bay is devoted to the making of chill castings in both types of alloys. The first bay is equipped at one end with two crucible furnaces. One furnace will hold six crucibles and the other four. Each crucible has a capacity of 220 pounds. The furnaces are heated by producer gas with heat regeneration. The large castings are molded by hand, on one side of the bay; the others are machine molded in the other side of the bay, where two hand operated molding machines and five power molding machines including one made by the Tabor Mfg. Co., Philadelphia, are installed.

The second bay contains six hydraulic roll-over molding machines, three stripping plate machines, one machine made by the Osborn Mfg. Co., Cleveland, and one machine made by the Tabor company. Molding opera-

tions are performed along one side of the bay, with the exception of the molding done on the two machines last mentioned. Shaking-out and sand-handling are carried out on the other side. Overhead traveling cranes supply transportation which principle is adopted generally in the foundry. Pattern-plates are used and the pattern metal is composed of lead, tin and antimony. The castings in this section of the foundry are made mostly of an alloy containing 92 per cent aluminimum and 8 per cent copper. The furnaces are installed in the third bay. These comprise one furnace with a capacity of 1760 pounds per hour heated by producer gas and a reverberatory furnace with a capacity of 660 pounds per hour, heated by producer gas.

Molds Are Cast Iron

The rest of the third bay is devoted to the making of chill castings, both in regular aluminum alloys and the modified 13 per cent silicon-aluminum alloy. Four crucible furnaces, each containing two crucibles of 220 pounds capacity are used for melting the regular alloys. Metal for the modified alloy is melted in nine furnaces, each containing two crucibles with capacities ranging from 150 to 220 pounds. These furnaces are heated by city gas. No machines are used for the chill castings. The chill molds are cast iron with steel cores. The output of the foundry can be divided roughly as two-thirds sand castings and one-third chill castings. Only a small percentage of scrap is used, and the mixture generally contains at least 80 per cent virgin metals. The average percentage of wasters for the whole foundry is claimed to be about 2 or 3 per cent.

Among the most interesting castings made in the foundry were 20 complete automobile chassis, made in the modified alloy. The thickness of the castings varies from 0.2 to 0.4 inch. The castings were molded in three-part flasks and a complete mold weighed 10 tons. Ordinary molding sand was used. A complete mold was 13 feet in length, 6 feet 6 inches in width and 1 foot high. The castings weighed only 352 pounds but 770 pounds of metal was required to fill the mold and gates. Each mold had five gates; two at the upper part, two near the middle and one at the lower part. These gates were linked by a canal. Five to six minutes were required to fill the mold and five ladles of 154 pounds capacity were used, one at each gate. Of 20 such chassis made to a special order, only two turned out to be defective.

Other castings commonly made by the concern are: Automobile pistons and connecting rods, wheels for automobiles and airplanes, complete one-piece back axles for automobiles and trucks, complete cylinder blocks, and various other parts for automobiles, all cast in the modified 13 per cent silicon-aluminum alloy, bearings used by a French railroad company, frames for seats in railroad cars, sliding doors for railroad cars, parts for diesel engines, automobile bodies, large vats made in several parts, fittings, etc.

Considers Federal Trade Practice Conference

The subject of federal trade practice rules was considered at a meeting of the Southern Metal Trades association held at the Piedmont hotel, Atlanta, Ga., Feb. 12. Phillip Gott, assistant manager, trade association department, Chamber of Commerce of the United States, addressed the meeting on the subject of trade practice conferences. He gave the members much information on the proper procedure in establishing federal trade practice agreements.

John S. Schofield, president of the association spoke on the same subject. Following this talk the advisability of adopting a set of federal trade practice rules was discussed. It was decided that the president should appoint a committee to study the question and submit its findings to the administrative council.

Driver-Harris Co., Harrison, N. J., has been awarded a gold medal for its exhibition at the Exposition Internacional de Barcelona, Spain, in 1929.

Round Tables and Luncheons Feature Conference

ROUND table discussions, which were described in the Feb. 15 issue of THE FOUNDRY, *were not the only points of interest at the fourth annual foundry conference, held Feb. 4 to 6 under the auspices of the college of mechanics and engineering, department of metallurgy, University of Wisconsin, Madison, Wis. The annual banquet was held on Tuesday evening at the Wisconsin Memorial Union and special luncheons on Wednesday and Thursday were attended by practically all of those attending the conference. The accompanying illustration shows a large number of those attending the annual foundry conference at the University of Wisconsin.*

Questions & Answers on FOUNDRY PRACTICE

GRAY IRON

Thin Castings Are Hard

QUESTION

We make small motor heads, 5 inches diameter, ⅛-inch thickness of metal poured two in a flask. Analysis of the metal shows: Silicon 3.00 per cent, sulphur 0.06 per cent; managanese 0.40 per cent and phosphorus 0.35 per cent. The castings are hard on the edge farthest away from the gates. In an endeavor to soften the castings they are put through an annealing oven about 60 feet in length with a capacity of 16 loaded trays. In the passage the castings require 1½ hours to arrive at the fire where they are held at a temperature of 1500 degrees Fahr., for 15 minutes and then travel slowly for 2½ hours until they arrive at the exit. This treatment does not seem to affect them. We shall appreciate your advice on this problem.

ANSWER

We are at a loss to understand why castings—even thin castings with ⅛-inch wall—should be hard with analysis of: Silicon 3.00 per cent, sulphur 0.06 per cent, manganese 0.40 per cent and phosphorus 0.35 per cent. Stoveplate founders and others engaged in the production of thin castings find no trouble in making satisfactory castings with ⅛ or even 1/10-inch thickness.

Are you by any chance making these castings in metal molds? If that is the case we can understand why under certain conditions they should be hard and need to be annealed. Your problem is peculiar and we should not care to venture a positive opinion without either a personal examination or a great deal more information on materials, equipment and methods of operation.

A possibility exists that your trouble may be due to the coke or a high blast or to a dense, wet sand that chills the iron. Try a heat or two with smaller charges and a reduced blast. Skin-dry a few molds for a start and also try a few in which the sand is as dry as it is possible to work it. See that the sand is porous so that steam may escape readily.

If the castings *must* be annealed then arrange to have them exposed to a temperature of 1600 degrees Fahr. for at least 1 hour. You can cut that hour off the approach which now takes 1½ hours. In other words shift the fire nearer the front of the oven. Some foundrymen claim that a small addition of nickel has cured hard areas when all the ordinary precautions and remedies have failed.

THIS department covers all problems relating to metallurgical, melting and molding practice encountered in making steel, malleable-iron and gray-iron castings. Questions submitted by bonafide subscribers to this department will be answered by members of the editorial staff of The Foundry, supplemented where occasion requires by the advisory staff whose personnel is as follows:

John H. Hall—Cast Steel
H. A. Schwartz—Malleable Cast Iron
J. W. Bolton—Gray Cast Iron

All questions should be addressed to The Editor, The Foundry, Penton Building, Cleveland.

Q & A

Adds Steel for Gears

QUESTION

What is a suitable semisteel mixture for gear wheels 48 to 54 inches diameter and weighing from 500 to 600 pounds. What is the proper amount of gray iron, steel, ferrosilicon and ferromanganese? How does the tensile strength of this material compare with that of ordinary gray iron, or with cast steel?

ANSWER

Without a knowledge of the raw material in your territory we are unable to specify the relative amounts of the various ingredients needed for semisteel gear wheels. The possible combinations are almost endless. However, for your purpose it may be sufficient to say that you will need to compound a mixture to yield the following analysis: Silicon 2.00 per cent, manganese 0.80 per cent, sulphur 0.10 per cent, phosphorus 0.30 to 0.50 per cent. The usual amount of steel scrap in a mixture of this kind is 25 per cent. When properly made this metal will show a tensile strength of approximately 40,000 pounds as compared with 25,000 pounds for good gray iron and 80,000 pounds for ordinary carbon cast steel. However, in this connection it is only proper to point out that attempts of amateurs to make semisteel usually result in failure. Satisfactory metal can be produced only under ideal melting conditions supervised by an expert melter.

Q & A

Wants To Remove Gases

QUESTION

We have been approached by a European business friend regarding trouble encountered in making certain large gray iron castings. Some layers of the material cool down so rapidly that the gases contained in the molten steel cannot escape which results in interior flaws and a general deterioration of structure. He states that he has heard about an American process whereby some chemical is added to the molten metal before pouring which allows the gases to escape. Do you know anything about this process?

ANSWER

While sulphur and some of the occluded gases in molten cast iron are claimed to be reduced by the addition of fused sodium carbonate, we doubt much if this material will cure the difficulty encountered. It appears to us as though the trouble arises from other causes than absorbed or occluded gases. In all probability the interior flaws and other gas holes are the result of internal shrinkage

and blows caused by improper feeding of the heavy castings, and improper ramming of the molds, hard cores, etc. If the riser used for feeding is too small, it will solidify before the casting and shrinkage will occur.

If the sand is too wet or rammed too hard, blows or kick-backs from the mold which will show up as holes in the casting may be expected. Even though dry sand molds may be used, this fault may appear if the right kind of sand is not employed. Some sands are too tight for proper venting, and the gases will follow the path of least resistance which is into the molten metal. Hard or poorly vented cores will prevent the egress of gases formed. When the pressure becomes high enough the gases are pushed into the liquid metal.

Q & A

Chills Iron in Wheels

QUESTION

We are making small sprocket wheels on which we would like to have a chill of ¼-inch on the working face. We place iron chills in the mold, but the best result we can get is a chill on the casting ⅛-inch deep and sometimes the chill is only skin deep. The second charge of 1000 pounds in our cupola from which these castings are poured is made up of 300 pounds No. 1 pig, silicon 2.75 per cent; 200 pounds No. 2 pig, silicon 1.50 per cent; 500 pounds car wheel scrap. We shall appreciate your advice.

ANSWER

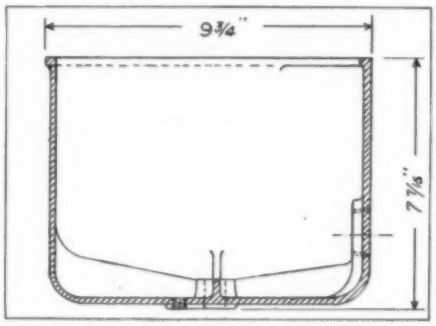
To secure a deeper chill you either will have to lower the silicon in your mixture, or use heavier chills in the mold. It may be necessary to do both. Lowering the silicon alone would cause the iron to chill deeper on the rim of the wheel, but also it would produce a harder iron all over the casting and that might interfere with machining operations on the hub which we assume is faced on both sides, bored out and fitted with a keyway. You may have to experiment a little to decide which course to adopt. Also you must bear in mind that an iron mixture and a set of chills that give perfectly satisfactory service on a 6-inch wheel, will not show the same results on a larger wheel with heavier sections of metal. To begin your experiments we suggest you substitute machinery scrap for the No. 1 pig iron. That will lower the silicon approximately 50 points and if that iron does not chill deeply enough in the castings you might substitute 100 pounds of steel scrap for a like amount of the car wheel scrap. In the event that you find it necessary to pour light and heavy wheels from the same charge you can make up the charge to suit the heavier wheels. A little ferrosilicon added in the ladle will render the metal suitable to pour the smaller wheels.

Q & A

Core Causes Blow Holes

QUESTION

We are forwarding for your inspection and opinion a blueprint and several broken sections from a small cylinder head cover which has caused us considerable trouble. The casting is poured in the position indicated and when it is shaken out we find a large cavity in the central hub. Our cupola is lined to 34 inches and we melt from 2 to 2½ tons without slagging. We use 750



THE CASTING IS POURED IN THE POSITION INDICATED WITH THE CORE SUSPENDED FROM A PRINT AROUND THE UPPER RIM

pounds to a charge, made up as follows: 150 pounds low silicon northern iron; 150 pounds high silicon southern iron, and 450 pounds clean machinery and agricultural scrap. We add 2 pounds of 50 per cent ferrosilicon to each charge in the cupola and an additional 2 pounds in each 700-pound ladle. The castings show an analysis of: Silicon, 2.33 per cent; sulphur, 0.09 per cent; phosphorus, 0.52 per cent; manganese, 0.61 per cent. Occasionally we have noted sparks arising when the metal is poured from the 700-pound trolley ladle into the hand ladles and have wondered if this indicated that the iron had been oxidized in the cupola and if this was responsible for the cavity in our castings.

ANSWER

Basing our opinion on the appearance of the fractured surfaces of the castings submitted, your iron is all that could be desired and therefore your cupola practice must be excellent. Your trouble is not metallurgical. It can be traced to your core room. Your cores either are too hard or not sufficiently dried, or both. The iron boils in the cavity in the bottom of the core. The metal sets before the boiling ceases and a cavity is formed in the hub of the casting. The logical way to cure the trouble is to make the core from a more open mixture, so that it will not cause the iron to kick. As an added insurance you might run a ¼-inch vent hole through the center of the core immediately above the hub and communicating with it. If any gas collects in the hub it will have a chance to escape through this vent hole. The iron of course will fill the opening, but it can be knocked off easily during the cleaning process. However, the latter purely is a supplementary measure. The better method is to provide a core that will not cause trouble and that is done either by venting it freely or making it from a natural venting mixture.

GENERAL

Divide Foundry Duties

QUESTION

We employ 85 molders and melt from 45 to 50 tons of iron daily for stoves and furnaces. At present the molders do their own pouring and shaking out, but we are thinking of dividing the work so the pouring and shaking out will be done by a special gang. Our castings are made on a straight production basis and vary in weight from a few ounces to 100 pounds. We shall appreciate your opinion on whether the present or the contemplated system is the better. Can you quote us the names of a few foundries formerly operating as we are which later changed over and divided the work among two gangs as we propose doing?

ANSWER

Modern trend of every industry, including the foundry, is to divide the work into as many sections as possible. The object is to increase production, decrease cost and perhaps most important of all, simplify the various tasks so that ordinary labor may be employed with a minimum degree of training. The idea has been developed to its highest degree in the continuous foundries where metal is melted and distributed during the entire working day, but many other foundries have found it advisable to so arrange the work that molders are employed continuously in making the molds, while other men with no particular training or skill, and consequently compensated on a lower scale are employed in doing all the odd jobs including pouring the iron and shaking out the castings.

In arranging the details practically every shop is a law unto itself. Local conditions, the amount of material to be handled, the class of labor available, existing relations or lack of relation with labor organizations, and many other features must be taken into consideration. In its broad general principles a reasonable division of the work is decidedly beneficial from an economic standpoint, but the application of the principles only

should be tried by an experienced foundryman with intimate knowledge of existing conditions in the plant where the change is proposed. Almost every issue of THE FOUNDRY contains reference to the methods in some foundry where the old fashioned method of the molder doing everything has been changed to a new fashion of dividing the work into many small sections among men who required little training and thus provided a flexible link in the transition period between peaks of low and high production.

In this connection have you taken into consideration that several engineering firms and manufacturers of foundry equipment have accumulated a vast fund of information on this subject of revamping foundries and foundry methods? Any of them will be glad to consider your proposition and conduct an expert survey. All the addresses may be found in the advertising pages of THE FOUNDRY.

Q & A

Casting Shrinks in Hub

QUESTION

We are attaching for your inspection a blue print for a small clutch which persists in showing shrunken areas inside the hub, despite the fact that we have tried different combinations of gates and risers. We shall appreciate your advice on how to secure solid castings.

ANSWER

Unfortunately the information supplied is rather meager on which to base an opinion. The print shows a small clutch 7½ inches diameter, 3⅝ inches deep with a hub 3⅜ inches diameter connected to the rib by a neck 2 inches wide at one side. The metal thickness in the rim is ¼ inch, while in the hub it is ¾ inch. One face of the clutch is closed while the other is open. The hub is bored for a 2-inch shaft so we may assume that it is cored to 1¾ inches. No information is given on the character of the iron employed or the position of the casting in the mold. Both of these features are important. The iron may be to blame, since in some instances, nothing but a change in the mixture will cure shrink spots. The position in which the casting is poured may be responsible for the trouble. Instead of speculating on these various features, we suggest the following method for molding and gating the casting, A possibility exists that you may be molding this casting face down on account of the fact that the face has to be machined. The casting should be molded and poured with the face on the cope side and suitable provision made in the gating to insure a clean casting. This gate may take the form of three or four pencil gates on the rim at the point farthest removed from the neck connecting the hub to the rim, or, a single deep, thin set gate at the same point. The idea back of this style of gate is to fill the hub with iron from the rim and therefore of a slightly lower temperature so that the shrinkage may be more evenly distributed.

The core, whether dry or green which nearly surrounds the hub, may be the cause of the shrink holes. Unless the gas escapes quickly and easily from this mound of sand it will set up a commotion that will chill prematurely the iron in the hub and thus prevent it from shrinking in a normal manner. Under ordinary conditions, poured with good iron and under a fairly high head, this casting should show no shrinkage. If a properly well made, well vented mold, in which the metal is poured under a reasonably high head, does not produce a solid casting, then it is fair to assume that the trouble is due to some abstruse cause that will require minute and painstaking investigation. In the meantime temporary relief may be secured by inserting a few horse shoe nails in the mold near the defective area. This will insure solid metal at these points.

STEEL

Aluminum Oxide Cores

QUESTION

We have heard that aluminum oxide and aluminum nitride are being used as coatings on cores used for steel castings. Can you give us any information on the proportions of these materials to be used?

ANSWER

Some time ago the use of aluminum oxide as a substitute for sand in difficult cores was suggested. However, the idea practically has laid dormant, except in a few cases, and the firms that are trying it are reticent about giving out any information other than the fact that aluminum oxide can be used for small cores, or for coatings on cores which are to be surrounded by heavy masses of steel. As far as we are aware aluminum nitride is not being used.

The refractory properties of aluminum oxide fit it for many high temperature services, and it is sold in the fabricated form as crucibles, tubes, laboratory boats, and in the granulated form. Aluminum oxide itself has no bonding power and is similar to silica sand. To obtain the best results, bonding agents of the highest quality will have to be used. While we do not have any data on the agents used, we believe that in the case of complete cores, that linseed, or a compounded core oil is employed. The only difference from sand cores is that the sand is replaced by aluminum oxide. In the case of core coatings probably the oxide is mixed with molasses water to give a thick, creamy solution which is rubbed into the sand core surface and dried.

MALLEABLE

Melts Nine Ton Heat

QUESTION

The cupola in our foundry is lined to 50 inches. The depth from the sand bottom to the bottom of the tuyeres is 9 inches in front and 7 inches in the back. What is the proper weight of coke to put in as a bed, the weight of the first iron charge, and the weight of subsequent iron and coke charges? We are pouring 9 tons of malleable iron a day and the work varies from 100 pieces to a pound to 5 pieces to a pound. What air pressure is necessary and how long should the blower be on before pouring? How long should it take to melt 9 tons of metal? Our mixture is made from half pig iron and half sprues.

ANSWER

A cupola lined to 50 inches inside will melt approximately 10 tons per hour calculated on a run of several hours. The cupola cannot be expected to melt as fast during the first hour as considerable heat is absorbed by the cold walls, etc. The bed should be put in by measure instead of by weight. It should extend 30 inches above the top of the tuyeres. With a single row of tuyeres, the bed coke will weigh around 2000 pounds. An easy way to put in the bed coke to the proper height is to take a ½-inch iron rod and bend one end so that a small foot about 4 inches long extends at right angles to the rod. Lower the rod through the cupola charging door until the foot is 30 inches above the tuyeres, then put a cut or mark on the rod at the bottom of the door. The first and succeeding charges of iron should weigh 2000 pounds with 275 to 325-pound coke splits. If your bed is lighted well and allowed to stand for an hour with the cupola fully charged and a peephole or two open, you should obtain good hot iron about 10 minutes after the blast is turned on. It is difficult to say just what air pressure should be used as it will depend to a large extent on the type of blower used and whether the charges pack tightly or loosely in the cupola. Between 6500 and 7500 cubic feet of air per minute should be supplied based on 275 or 325 pounds of coke. The blast may run between 14 and 18 ounces according to cupola condition as mentioned.

Problems in Nonferrous Founding

By Charles Vickers

Alloy Resists Heat

We are trying to cast brass water fronts for stoves but are not meeting with any great success. We get first class castings in appearance but they are not water tight, and as soon as the pressure is applied the whole casting leaks. We are using the same molding sand and cores as we use to make the castings in gray iron and so believe this practice must be correct, but it is possible we are using the proper mixture of metal in the brass castings. Some advise us that we are not using enough copper in with the brass scrap, while others claim we are using too much. Can you advise us in regard to the matter?

It is possible that we could advise you provided we had the least idea of what your present practice may be. The persons who informed you that you failed to have enough copper in the mixture are far more likely to be correct than those who stated there was too much. As a guide we will mention that if you are using a miscellaneous yellow brass scrap, then you are certainly lacking in copper in the mixture. On the other hand if the metal is practically all copper, it is probable that some improvement would result by reducing the copper and adding some tin.

Usually for nonferrous castings exposed to fire, for instance blast furnace tuyeres, copper is the metal used. Usually all it contains in addition to copper is phosphorus to secure a sound casting. We suggest that the scrap be ignored when it comes to making such castings, and that the alloy be compounded from the virgin metals using 89 pounds of copper and 1 pound of nickel. The nickel should be melted with the copper, and instead of using the pure metal, use the alloy known as 50-50 copper-nickel, which can be bought already made. Two pounds of the 50-50 alloy should be used to introduce the 1 pound of nickel and the odd pound of copper thus introduced should be deducted from the 89 pounds previously mentioned. Melt these together under charcoal, or some covering put in the crucible with the copper. When the charge is molten and freely liquid, add 2 *ounces* of phosphor copper, then 2 pounds of zinc; 6½ pounds of tin, and 1½ pounds of lead. Stir well, cover with more charcoal and close the furnace and get the metal hot. Pour at from 2100 to 2150 degrees Fahr.

Q & A

Deoxidizes Bronze

In making aluminum bronze of the formula copper 90 per cent, aluminum 10 per cent, what is the best substance to use to deoxidize the copper before adding the aluminum? Also can small castings of aluminum bronze of the above formula be hardened after they are machined to increase the wearing qualities? If so, what is the process?

The best deoxidizer to add to copper in making aluminum bronze is about 1 per cent yellow prussiate of potash. This is weighed, put into a paper bag which is dropped lightly onto the surface of the molten copper. The surface of the copper should be well covered with charcoal previously to float the bag of prussiate. As the prussiate gets heated it will boil due to the water of crystallization being driven off, then it will fume. At this point it should be stirred into the metal. These fumes should not be breathed as they are poisonous, but the yellow prussiate is not. After stirring in the prussiate, the copper will be deoxidized thoroughly, and it will also be hardened somewhat. The aluminum now can be added. If the metal can be skimmed, it will be better. The pot then is covered with charcoal, which leaves nothing for the aluminum to attack. The bronze should be mixed thoroughly before it is poured. If that practice is followed, good, clean castings should be obtained that will have good physical properties.

A second choice in deoxidizers for the copper is the 30 per cent manganese copper. Add one-half of one per cent to the copper before the aluminum is added. It must be understood these deoxidizers are for use only in the copper part of the charge, they cannot be expected to deoxidize aluminum. All they can be expected to accomplish is to remove oxygen from the copper, so that on the addition of the aluminum, a minimum of alumina will be formed within the alloy itself. Aluminum bronze can be hardened by heat treatment, but it is better to make the bronze harder by alloying. Add 10.5 per cent aluminum instead of 10 per cent aluminum, the resultant alloy will be better in every way than the 10 per cent bronze.

Q & A

Metals Will Not Mix

One of our problems with which we are now confronted is how to make a homogenous admixture of cast iron and copper with the copper content ranging from 5 to 25 per cent. Can you tell us how to do this?

When cast iron and copper are melted together the two metals will separate on cooling, and while the iron may hold a certain content of the copper, we doubt whether this will amount to 5 per cent. The higher amount of copper will not alloy with the cast iron at all and the reason for this is that the iron holds carbon in solution and the copper has no affinity for carbon and will not alloy with any metal containing it. Copper, however, will diffuse through cast iron as shown by the late H. E. Diller, in a paper presented at the Philadelphia meeting of the American Foundrymen's association, Sept. 29 to Oct. 3, 1919, in which he described experiments to ascertain the effect of different oxidizing packings on annealing malleable iron. In one of the tests a bar of iron was imbedded in copper-oxide packing and annealed at 1000 degrees Cent. (1832 degrees Fahr.). It was found that the copper-oxide had been reduced to copper and melted and that it had penetrated into the iron. It was shown that the carbon had been reduced from 2.70 to 0.60 per cent and that there was 21.4 per cent copper present. It is our opinion, based on experimental work we have carried out, that it will not be found possible to make a homogenous alloy of copper and cast iron.

The FOUNDRY Family Photograph Album

Upper Left

N. ELDREDGE
Eriez Stove & Mfg. Co., Erie, Pa.

Upper Right

F. E. HINNERS
George H. Smith Steel Casting Co., Milwaukee

Lower Left

H. T. HERR, JR.,
J. S. McCormick Co., Pittsburgh

Lower Right

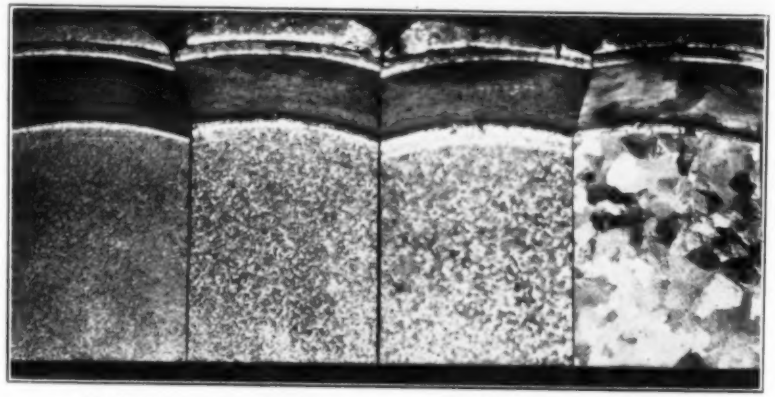
JAMES H. ANDERSON
Litchfield Mfg. Co., Waterloo, Iowa.

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

NEED ALUMINUM TEMPERATURE CONTROL

One of the most frequent causes of trouble in the production of aluminum castings is the lack of proper pyrometric control. While occasionally the melting and pouring temperatures are disregarded or considered unimportant, success in the founding of aluminum cannot be assured unless this first step in the process is carried out properly. As a rule, castings poured at elevated temperatures have a coarse grain structure. This is clearly shown in the accompanying illustrations. The same is true of castings poured at the correct temperature but from overheated metal or from metal held at an elevated temperature for any appreciable length of time. Coarse grained castings are generally unsound and have inferior physical properties as indicated in Fig. 2.

The grain structure in a casting is governed largely by the rate at which the casting solidifies. With a more rapid rate of solidification, a



1320°F. 1400°F. 1500°F. 1700°F.

FIG. 1—THE EFFECT OF POURING TEMPERATURE ON THE GRAIN SIZE OF CASTINGS OF AN ALUMINUM-COPPER ALLOY CONTAINING 8 PER CENT COPPER (NO. 12 ALLOY). THE METAL WAS HEATED TO AND POURED AT THE INDICATED TEMPERATURES ACCORDING TO T. W. BOSSERT, *TRANS.* A. F. A., 1928

finer grain structure will result. For this reason, the pouring temperature should be the lowest temperature at which the mold can be filled without too much danger of a misrun occurring.

Guess work should be eliminated as far as possible in determining the proper pouring temperature. Where production is sufficient to warrant, this temperature should be set by actual test; and once it is determined, it should not be changed unless, of course, the method of gating

(*Continued on Data Sheet No.* 804)

NEED ALUMINUM TEMPERATURE CONTROL

(*Continued from Data Sheet No.* 803)

or the alloy is changed. A simple and expedient way to determine the proper pouring temperature is to pour several castings at different temperatures. The first casting should be poured with metal which is known to be hot enough to fill the mold; the second casting, with metal at a slightly lower temperature; and so on until the first misrun results. A

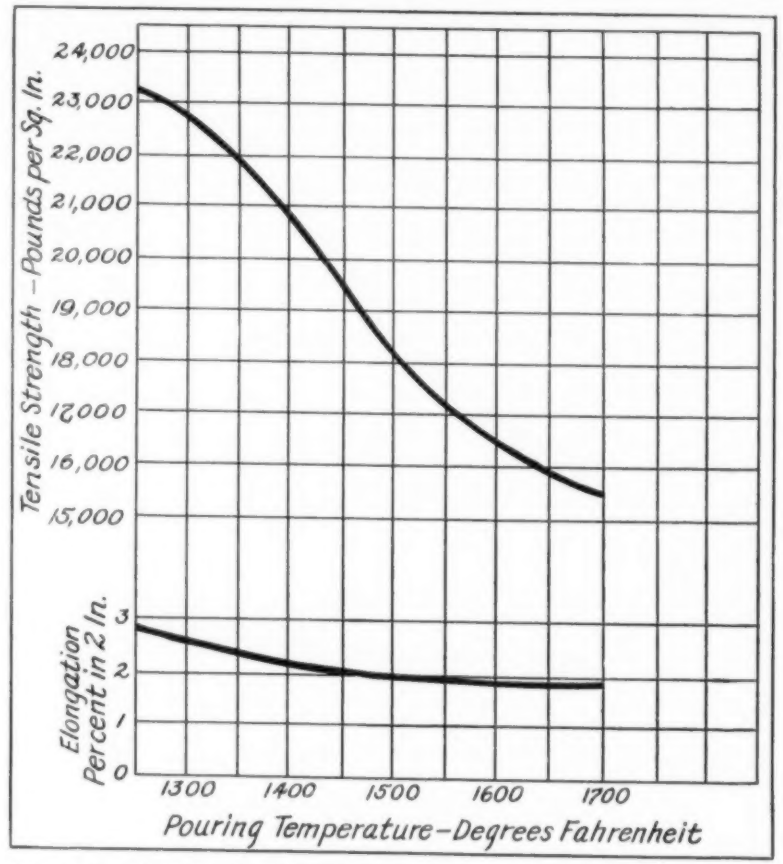


FIG. 2—EFFECT OF POURING TEMPERATURE ON THE PHYSICAL PROPERTIES OF SAND CAST NO. 12 ALLOY TEST BARS 0.505-INCH IN DIAMETER

(*Continued on Data Sheet No.* 805)

Pouring Speed

May Be Adjusted with Precision

By H. W. DIETERT

IMPORTANCE of the proper rate at which a casting should be poured should be considered by every foundryman. Many believe that it is sufficient to regulate the flow of iron to prevent cold shuts on one extreme and to prevent straining the molds on the other. Either of these extremes will give a casting, but are too far apart to give a perfect casting which is demanded.

Every different pouring rate will give a casting of different quality because the cooling rate of the molten metal will be different. This variation in cooling will result in case of slow poured castings, in hard brittle castings, and in the case of those poured fast, castings with segregations and internal strains. Considerable care is exercised in mixing the metal. In many foundries a separate department is maintained just to perform this important process of mixing and melting. After the molten metal leaves the hands of the melter little exactness is exercised to see that the molten metal freezes or sets at a definite cooling rate. Micrographs are made of the test bar to control the structure of the iron. This control is not productive in providing castings of a definite structure unless the rate of pouring the casting is standardized for each class of casting because the structure of iron largely depends upon the rate of cooling. Every foundryman is a heat treater in a sense, and the sooner he discovers his basic profession, the sooner he will be rewarded with better castings. Possibly a little light will be thrown on the subject if it is said that a casting should be poured at a rate or fed so as to cause or approach a progressive freezing of the metal from the far end to the gate side of the casting. Unfortunately, wherever exactness is dealt with, a definite law must be set up. These laws or mathematical equations are not always simple. The first step in developing the mathematics of gating of a casting was to determine the pouring time of every type of castings in six foundries.

Castings ranged from small bench work to those weighing 1000 pounds. Mold dimensions varied from 6 x 10 inches to 6 x 6 feet. By plotting the weight of the casting against the pouring time, it was found that a line drawn through the average of the numerous points obtained gave a smooth curve as shown in Fig. 1. By grouping the various thicknesses of metal stocks, curves *A*, *B* and *C* were obtained. These curves are called the pouring time. The curves are used as follows: Assume the predominating thickness of casting walls is ¼-inch and the casting weight 100 pounds and it is desired to find the time required for pouring the casting. Using Curve *B* in Fig. 1, find the weight of the casting at the bottom of the chart. Follow the line at 100 pounds vertically upward until it intersects the Curve *B*. This point corresponds to 12.5 seconds which is the proper pouring time for a 100-pound casting, ¼-inch thick, poured one up with iron at 2400 to 2500 degrees Fahr.

The correct time in which a casting should be poured also may be calculated from the formula which follows:

Pouring time in seconds = $S\sqrt{W}$ (Formula A)

Where

A = Weight of casting in pounds

S = 1.1 for a casting with 7/64 to 9/64-inch stock
S = 1.25 for a casting with 10/64 to 20/64-inch stock
S = 1.5 for a casting with 21/64 to 39/64-inch stock

The calculated pouring time will check with the pouring time obtained from the curves given in Fig. 1. This principle of gating may be applied in several ways. For example, use a stop watch to obtain the pouring time of a casting. If the pouring time is found to be 28-seconds for a 400-pound casting with a stock of ⅞-inch, and the chart shows the pouring time to be 26.2 seconds, the size of the gate may be increased by approximation until the pouring time is close to that calculated. The rate at which molten metal will flow through a gate will depend upon the ferrostatic pressure on the reduced sections of the gate called the choke or check. The ferrostatic pressure will depend upon the height of the

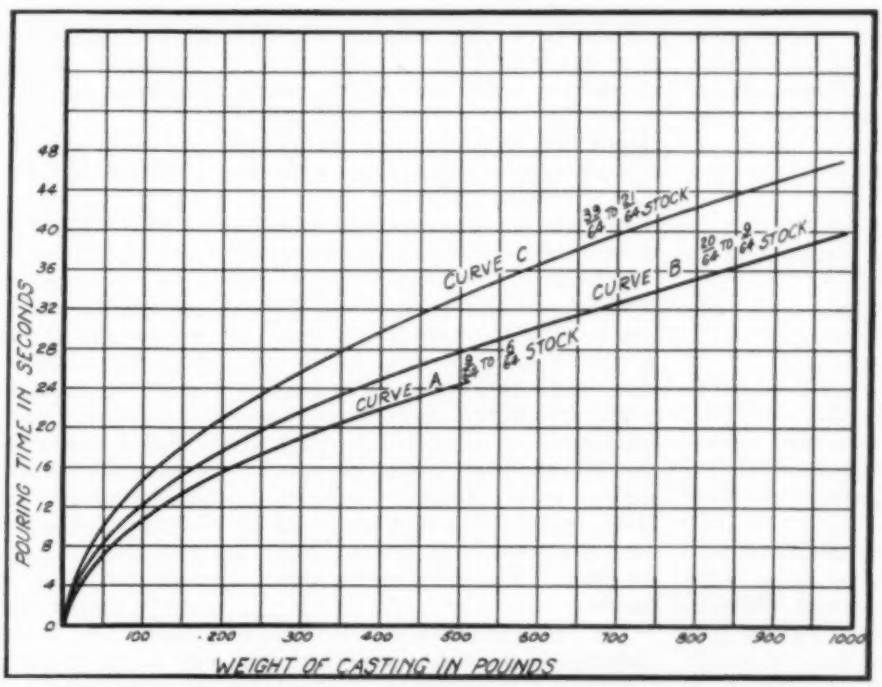


FIG. 1—DIAGRAM SHOWING THE TIME REQUIRED TO POUR CASTINGS CORRECTLY WITH DIFFERENT METAL THICKNESSES

sprue and the location of the casting in the mold. When the mold fills up with iron, the height of the sprue is diminished. Therefore, the effective sprue height is the item of interest. The first step in calculating the area of choke is to determine the effective sprue height. To determine the effective sprue height above the choke employ the following formula:

$$\text{E.S.H.} = \frac{2H \times C - (P)^2}{2C} \quad \text{(Formula B)}$$

Where
H=Height of sprue above the choke
C=Height of casting
P=Height of casting above parting line

Fig. 2 gives diagrams illustrating the parting lines in various types of molding. All dimensions should be used in inches.

The area of the choke required to feed a casting properly depends upon the pouring time required for proper cooling and effective sprue height. The area in square inches of the choke may be calculated by using the following formula:

$$\text{Area of choke} = \frac{X\sqrt{W}}{\sqrt{\text{E.S.H.}}} \quad \text{(Formula C)}$$

Where
W=Weight of casting in pounds
E.S.H.=Effective sprue height obtained from Formula B

$X =$ 0.38 for castings with 21/64 to 39/64-inch stock; 0.32 for castings with 10/64 to 20/64-inch stock; 0.28 for castings with 7/64 to 9/64-inch stock

A good method of applying the gating principle is to calculate the area of the gate before or after the pattern is made, and actually place a gate with a choke of the size calculated by the use of the formulas given.

Determine Pouring Time

For example, assume that the casting has a stock of $\frac{3}{16}$-inch; weighs 100 pounds, and will be gated at the parting line as shown in Fig. 2. Following the designations in Formula *B*, the value for *P* is 15 inches; *C* is 26 inches, and *H* is 20 inches. The calculations follow:

$$\text{E.S.H.} = \frac{2H \times C - (P)^2}{2C} \text{ or}$$

$$\text{E.S.H.} = \frac{2 \times 20 \times 25 - (15)^2}{2 \times 26}$$

$$= 15.7 \text{ inches}$$

$$\text{Area of choke} = \frac{X\sqrt{W}}{\sqrt{\text{E.S.H.}}}$$

$$\text{Area of choke} = \frac{0.32\sqrt{100}}{\sqrt{15.7}}$$

$$= 0.81 \text{ sq. in.}$$

Then actually make the cross sectional area of the choke, 0.81 square inches, and the pouring time will be around 12.5 seconds within practical limits.

While the principles described were worked out and applied in a large corporation having several different gray iron foundries, the figures may vary for other foundries. However, these principles may be applied to pouring in any foundry by a little effort. Check the pouring time of all castings in the foundry and plot results as shown in Fig. 1. Then draw conclusions whether castings poured from data obtained from the average curve give better results than when poured so as to check with other castings that are poured on the curves.

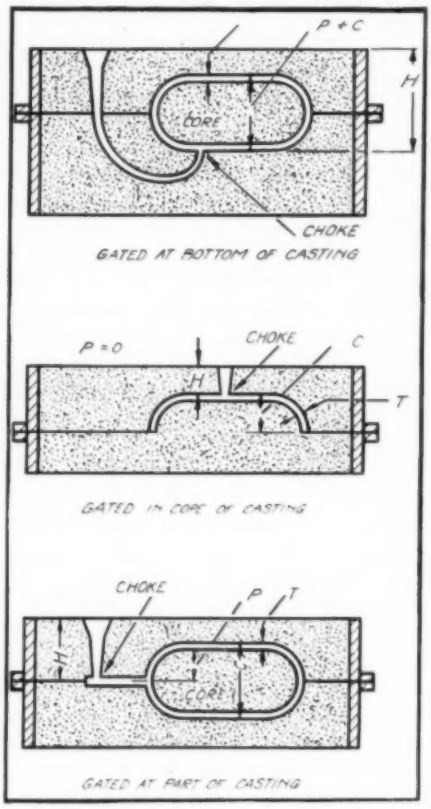


FIG. 2—SKETCHES SHOWING DIMENSIONS USED IN THREE DIFFERENT LOCATIONS OF PARTING LINES

If they are poured other than regular, know why.

Formula *A* for pouring time as given herein will hold undoubtedly for all molten metals and various stocks of casting. The constant *S* should be determined carefully for individual conditions other than those agreeing with conditions mentioned.

Formula *B* for determining effective sprue height will hold for any metal.

Formula *C* for calculating the area of choke will only hold for any molten metal. The Constant *X* will have to be determined for each metal other than cast iron and stocks as listed.

The area of the choke for each new job should be calculated to eliminate the experimental gating period and insure sound castings immediately. Many years of experimental gating have perfected your present gates in the shop. Why not express these in figures.

The formulas given will cover many classes of castings. However, considerable data must be collected before exact formulas may be given which will cover all classes of castings and metals.

Undoubtedly steel foundries will be profited to a larger extent due to the greater sensitivity of steel in regard to cooling and shrinkage.

The constant *S* in Formula *A* should be determined by some investigator for castings in groups lying in between 39/64-inch and 1-inch stocks. After this work is completed Constants *S* and *X* may be expressed as a function of stock.

Appoints Committee on Foundry Safety

The general chairman of the metal divisions of the National Safety council has appointed the following committee on foundry safety: F. G. Bennett, Buckeye Steel Castings Co., Columbus, O., chairman; Robert L. Schmitt, Louisville Car Wheel & Railway Supply Co., Louisville, Ky.; E. G. Quesnel, Commonwealth division, General Steel Castings Corp., Granite City, Ill.; W. E. Watters, National Malleable & Steel Castings Co., Melrose Park, Ill.; S. W. Doran, personnel superintendent, Pratt & Letchworth Co., Buffalo, and John P. Eib, Illinois Steel Co., Joliet, Ill., general chairman of the metals section. That committee will hold a meeting in Chicago, March 19 when a special program on foundry safety will be arranged for the next National Safety congress to be held in Pittsburgh, Sept. 29 to Oct. 4. Mr. Bennett, chairman of the committee, long has been interested in foundry safety and has held a position on this committee for the past several years. According to federal statistics there was a marked reduction in foundry accidents during the year 1928.

Issues Information on Chemical Engineering

University of Michigan, Ann Arbor, Mich., has issued a booklet giving information on the courses in chemical engineering offered at that institution. Material includes general information about the university and its facilities, advantages of advanced education, admission and graduation requirements, a detailed list of the material studied in the courses, a list of the courses offered, and a list of the various investigations and reports that have been published by the present staff of the chemical engineering department. The booklet may be obtained by addressing the Chemical Engineering department, University of Michigan, Ann Arbor, Mich.

Bill Tells Why Steel Wheels Crack

By Pat Dwyer

THE ceaseless activity of a certain lady in what she is pleased to call "tidying up around the house," led me several years ago to preempt a certain drawer for my own individual use. In it I keep various odds and ends, essential to a man when he sits down occasionally to transfer some of his burning thoughts to paper. Letters, clippings from papers and magazines, odd notes on scraps of paper, a few pencils, a spare ribbon, a dozen pipes and a few papers of tobacco constitute the principal items.

When I adopted this plan I anticipated a long period of peace and comfort. Here, I said to myself, is a place where there is a place for everything and everything in its place. No more prowling from the attic to the cellar, vainly searching for some precious item. No more meeting a surprised "Oh! Those old crumpled scraps of paper you left on the window sill? I did not think they were any good. Nice looking stuff lying around. I swept them up and burned them!"

The individual drawer appealed to me as the ideal solution of the problem, but the idea has not worked out so well in practice. Through some mysterious feminine process of reasoning the lady decided that this pet drawer of mine is just a catchall. Every conceivable object for which there is no definite place, is crammed into it.

Fortunately I am a man of infinite patience. Up to a certain point I am content to sink a shaft and prowl among the debris for what I want, but when the accumulated rubbish rises to a height where I find it practically impossible to open the drawer or close it, I am forced to adopt drastic measures. I await a favorable opportunity and when the coast is clear I take the loaded drawer down to the cellar and dump the contents on the floor. I carefully salvage my own material and shove all the rest in the furnace. It never is missed and I submit that is a fair indication of its value and justification—if justification is needed—for the action. In this periodical purification process the other night I found a copy of Longfellow's poem, Evangeline. Several weeks before, I had occasion to look up a passage in the book, but strange to say no one had seen it. I spent several hours hunting in every possible and some impossible places for it, but I overlooked the one best bet, the old pet drawer. How it ever found its way to the bottom of that drawer ever will remain a mystery. Naturally I have my suspicion, but experience gained over a period of many years leads me to keep my suspicions to myself.

After I had reassembled the rightful contents and restored the drawer to its place, I lighted a pipe and reread the old classic. It always has been a favorite ever since I first read it in school. The story itself appealed to me for its dramatic quality, but my chief pleasure was derived from the beauty of its composition and its presentation in rolling hexameters.

The story rises to tragic heights at various points, but to me the most poignant and agonizing passage deals with the episode where Gabriel and Evangeline, each searching for the other, pass each other unknowingly on the Mississippi.

Nearer, ever nearer, among the numberless islands, darted a light, swift boat that sped away o'er the water. Urged on its course by the sinewy arms of hunters and trappers. Northward its prow was turned, to the land of the bison and beaver. At the helm sat a youth, with countenance thoughtful and careworn. Dark and neglected locks overshadowed his brow, and a sadness somewhat beyond his years on his face was legibly written. Gabriel was it, who, weary with waiting, unhappy and restless, sought in the western wilds oblivion of self and of sorrow. Swiftly they glided along, close under the lee of the island; but by the opposite bank, and behind a screen of palmettos, so that they saw not the boat, where it lay concealed in the willows. All undisturbed by the dash of their oars, and unseen, were the sleepers. Angel of God! Was there none to awaken the slumbering maiden. Swiftly they glided away, like the shade of a cloud on the prairie. After the sound of their oars on the tholes had died in the distance, as from a magic trance the sleepers awoke, and the maiden said with a sigh to the friendly priest, "Oh Father Felician! Something says in my heart that near me Gabriel wanders."

Just as near as that! A few minutes and a narrow island, but it separated the lovers as effectually as 100 years if such a thing was possible, and half the circumference of the earth. The incident prolonged the weary quest until Evangeline, faded and old, finally found the remains of what had been the gallant lover of her youth, breathing his last among other victims of the plague in Philadelphia. One flash of recognition and—the end. Tough luck. By a curious coincidence I had a letter today from an old friend informing me among other items, that we had missed meeting each other recently in a distant city by an exceedingly narrow margin. He arrived in the city one morning to take charge of

THE TRIP IS A FROST. NO FOUNDRIES TO VISIT

a certain plant. I visited the office of the same plant that morning while he was out prowling around the shop. Neither one was aware of the other's presence. So far as he knew, I was toiling away like a busy little beaver in Cleveland. The last time I had heard from him he was down in Texas doing a yeoman's job in holding the wolf away from the door of the old homestead.

I left for home the same night and thus lost one of the keenest of life's pleasures, that of foregathering with a trusty old friend where the tongue can wag without fear and without restraint.

The lady who occasionally does me the honor of listening to the recital of the events of the day did not offer me any sympathy. "It is a good thing you did not meet him," she said, "or you probably would be down there yet. The crabby old bachelor who vilified us as the talkative sex, never sat in on a session of two or more old foundry cronies." Between ourselves, of course that statement is a gross libel, in proof, I have only to say that I allowed the statement to go unchallenged. 'Tis a grand recipe—sometimes—for terminating an argument. Later in the evening Bill dropped in and I mentioned the incident of the letter. Partly because Bill is a mutual friend naturally interested in this personal item, and partly because the incident illustrated the well known statement that truth is stranger than fiction.

"Well," said Bill, "I'll tell you. This world is a small place after all. Last summer up on Mackinac island we went for a sight seeing jaunt in one of the horse drawn carryalls with which the place is infested. The young driver was a total stranger when we started, but before the journey was finished we discovered that his sister and one of my daughters had trained in the same hospital."

"What do you mean *we*" I asked, "and of all places, what took you prowling up around Mackinac island?"

"Well," said Bill, "it is a long story, but we have lots of time. Listen my lad and don't talk back and I'll tell you the story of Mackinac, Poetry if anyone should happen to ask you! Throwing off little gems like that is just a natural gift. Did you ever hear the one I composed about—?"

"No," I interrupted hastily, "and what is more to the point I don't want to hear it, if it is anything like the sample you have just submitted. If that is poetry then I am a yellow hammer with a wooden leg. Any person could compose that kind of drivel: He lifts up his voice, alas and alack and the burden of his song is just Quack, Quack!

"Quack away, my hearty, but kindly confine yourself to ordinary prose. It is good enough for me. I am rather curious to know why you went to Mackinac island. I never heard of any foundries up there."

"Your hearing is improving." Bill commented drily. "I examined the place closely, but found no trace of a foundry. However, I did not shed any tears over the discovery. One of the reasons I had for going there was to get away from the foundry for a couple of weeks and certainly that little island between lakes Huron and Michigan is enough to make one forget that such places as foundries exist.

THE NOBLE RED MAN FEARS HE IS BEING GYPPED

"Ice bound in winter and thronged with tourists in summer, the island has enjoyed a peaceful existence for over 100 years, but the old log block house with loop holes in the walls, with musket balls deeply imbedded in the wood, involuntarily carries one's mind back to an earlier day when two mighty nations struggled for the possession of a continent claimed by each originally through right of discovery and occupancy.

"Dainty cavaliers decked out bravely in rapiers and ribbons, swashbuckling bravos in jack boots and war cloaks, rubbed shoulders with hunters, trappers, voyageurs, courier du bois and common soldiers from every walk of life.

"Black murder and sudden death stalked grimly through the early part of the story. Painted Indians with their tomahawks, wampum, war paint and feathers flit in and out of the story as they at one time flitted through the trees of the forest, or darted from cover to cover while conducting an attack on the block house.

"The two little cemeteries situated on the high ground about half a mile back from the village, contain many markers erected to the memory of men who died violent deaths in those far away days. Even in death their friends would not allow them to lie peaceably together. Filled with the spirit of youth and of high adventure these men had crossed the wild salt sea and penetrated 1000 miles into the wilderness of North America. Heroes, every one, whether they followed the blood red war banner of England or the fluer de lis of France. Dreams of fame and fortune were cut short by a slug from a musket and for 100 years they have been lying in this quiet place where the leaves of the maples curl tender and green in the spring, symbolic of their coming and where the same leaves flame in the fall, a riot of scarlet glory to match the manner of their passing. A heroic bronze figure of Pere Marquette stands in the village green facing the open water and supplies a startling link with the present and the far away past when this dauntless missionary stood in the same place, the first white man to gaze on this virgin land and water. From here he set out with Louis Joliet to explore the Mississippi and it was to Mackinac he was returning when his heroic spirit finally took flight from a body worn by years of hardship and privation at the mouth of a little river flowing into lake Michigan. A river that still bears the name of one of the most illustrious sons of France.

"Mackinac first rose into prominence as a fur trading station and fort in the days of Cadillac, a fire eating, two handed fighting man, who afterward established a fort and trading station on the present site of the magnificent city of Detroit.

Indians brought their fur packs for 500 miles to exchange them for blankets, hatchets, knives, beads and cooking utensils. Also for French brandy. The session usually ended in a prolonged drunken debauch.

"Mackinac was a recognized trading center for the Chippewas, Sacs and Foxes from the surrounding territory, the Sioux from Minnesota and Wisconsin and the Crees who hunted to the north as far as Hudson Bay.

"The fur trade fell off to an

alarming degree when English traders began to invade the territory and dispense rum. French brandy was more expensive than the potent firewater distilled from molasses. The English traders won hands down when the noble red man discovered that he could get twice as much rum as brandy for his skins. One bottle of brandy rendered him frisky, but two bottles of rum insured a temporary trip to the happy hunting grounds.

"Early in the past century after the tumult and the fighting had died down, a canny young lad named John Jacob Astor decided to make a few million dollars in the fur business. He established a string of trading posts through the great unexplored Northwest as far as Oregon. The town of Astoria on the Columbia river, later formed the main issue in the American claim to the territory. John also maintained a post on Mackinac island. The original building now is operated as a combined museum and hotel where visitors are shown through for the nominal fee of two bits. The hard wood beams the planks of the floor and walls, still bear the marks of the axe with which they were hewn to shape. The beams are notched and mortised and the planks are fastened cunningly in place with wooden pegs instead of nails. The doors swing on massive hand wrought iron hinges that sprawl in great curves half way across the face.

"A 6-foot wooden wheel is mounted over a trap door through which the bales of furs were hoisted to the second floor. Ancient prints adorn the walls and an old account book is exhibited containing entries in a right clerkly hand showing the credit and debit entries of the various trappers who had dealings with the fur company. The atmosphere of the place is so realistic that if I had slept there I should not have been at all surprised to wake in the middle of the night too see a ghostly procession of trappers with long rifles, fur caps, buckskin shirts, *ceinture fleche* and *bottes sauvage*, traipsing through the room and making whoopee!

"Reference to the big wooden wheel reminds me of an inquiry I had recently from a man who wrote that he was making a small 6-arm wheel in green sand from electric steel. The arms crack about 1½ inches from the rim after the wheel has been in service a short time. When cast, the wheel shows a slight shrinkage on the outside of the rim opposite the end of each spoke. The arms are flat, 1¾ inches wide and ¼-inch thick, reinforced on the upper edge by ribs ¼-inch thick, tapered to ⅛-inch. The hub is surrounded by an oil chamber somewhat similar to that on ordinary small cast iron wheels.

"The castings are poured from a metal which analyzes: Carbon 0.25-0.30 per cent, manganese 0.45-0.50 per cent, silicon 0.30-0.35 per cent, phosphorus 0.04-0.05 per cent, sulphur 0.04-0.05 per cent. They are annealed by being raised to a temperature of 1560 degrees Fahr., and then allowed to cool to below 1000 degrees, when they are drawn. He wrote that he would appreciate my opinion on the probable cause of the wheels cracking and how it may be prevented. Also what method I would suggest to prevent the shrinkage marks on the rim.

ONCE MORE, BOYS, "ALL AROUND THE MULBERRY BUSH!"

"The design of the wheel with a comparatively large body of metal around the hub as compared with the light rim is primarily responsible for the cracked spokes and the shrinkage marks. The trouble is accentuated by the practice of pouring the wheel on the hub. With any style of gate the metal will remain hot at the hub for a longer time than it will at the rim, but where all the metal for the wheel flows through the hub it is only natural to find that the hub will remain hot for an excessive period as compared with the rim where the metal sets and cools quickly in a green sand mold. As a result of the combination, the rim contracts first and stops, then the hub contracts and sets up a strain in the metal where the spoke joins the rim. In cast iron wheels arms of this character usually crack while in the mold, but the elongation factor in steel holds the casting in shape for some time after the wheel is placed in service. Ultimately the constant knock from the rail joints ruptures the arms at the weak points. The obvious solution is to change the design of the wheel to equalize contraction strains. However ,if that is out of he question. I suggested that he pour the wheel on the rim and strip the hub immediately after the metal has set.

"This may be accomplished by any one of several methods. The mold may be turned on edge to facilitate the removal of the sand around the hub with a steel bar. A round plug like a gate pin or a piece of pipe may be rammed in the cope about one inch back from the hub between each pair of arms. The plugs are withdrawn after the mold is poured and the cavities filled with water. The center core also should be punched out to permit circulation of air at that joint. The annealing temperature and metal analysis conform to accepted steel casting standards and I assumed that he poured the metal at a temperature that precludes misruns and cold shuts. The foregoing refers to the regular run of castings and to what has come to be regarded as fairly well standardized electric steel foundry practice. Occasionally a defect turns up which at first seems quite normal, but which later presents a great many baffling features before it is solved in a satisfactory manner. Thus, in this instance the first conclusion to which one would jump is that the cracked arms are due to the metal, either in the composition or in the manner in which it is manipulated in the furnace. Comparison with other castings poured from the same heat or heats, will either confirm or disperse this opinion. In passing it is only fair to point out that spoked wheels always have constituted one of the most aggravating classes of castings from a steel foundryman's view point. The uneven contraction strains set up as a result of the shape and the relative position of the hub, the rim and the spokes have to be anticipated and taken care of in some manner after the castings have been poured. Naturally the best method to adopt in any particular case will depend on local conditions. In this particular instance a plug rammed between each pair of arms and removed before the mold is closed, probably will furnish the necessary factor of safety. The annealing process may be at fault.

Fundamentals of
FOUNDRY PRACTICE

Density of the Rammed Sand Is an Important Feature in Making the Mold and in the Appearance of the Casting

By Ivan Lamoureux

[Interpreted in the Light of American Practice by Pat Dwyer]

Part V

BEFORE it is applied to the molding of castings, the sand is prepared methodically and carefully to mix as intimately as possible the essential elements of which the old and new sand are composed. The part played by charcoal and coal dust at the time of pouring and the reasons why it is absolutely necessary to insure the escape of the gases developed in the molds, have been described previously.

The main volume of the gases escapes from the molds through the uninterrupted spaces existing between the grains of sand. However, it is obvious that the presence of these spaces, or voids, their number and size, depends to a great extent on the manner in which the sand has been rammed.

Must Ram Uniformly

Sand must be rammed sufficiently to prevent soft places in the mold and consequent lumps on the casting; to prevent breaking the sand in projecting parts; to permit handling of the flask; lifting out the pattern, and the assembly of the various parts of the mold without any sand dropping off. Sand that is rammed too hard will cause scabs due to the lack of permeability. It prevents the removal of the pattern without breaking parts of the mold.

Sand must be rammed uniformly. A part not rammed hard enough will yield when the mold is filled with metal. A spot that is too hard will cause the metal to bubble. Ramming is an important feature and must be done reasonably if clean impressions are desired and if the gas is to escape readily.

For small molds the sand is rammed with a rammer made entirely of wood. On large molds where considerable force has to be employed the rammers are made of a wooden shaft provided on the ends with iron or steel heads. Some rammers consist of an iron rod pipe ¾-inch in diameter, the ends of which have forged iron heads, these being the most solid. Small rammers carry a peen at one end and a flat butt at the other end.

The end of the rammer used for peening the sand should have a thickness of at least ⅜-inch and a width of at least 2½ inches. The size of these ends varies between ⅜ and ⅝-inch in thickness, 2½ and 3¼ inches in width, 2 and 2¾ inches in height.

The rounded butt of the rammer varies between 3¼ and 4 inches in diameter and ⅜ to ⅝ inch in height.

Ramming the Sand

GENERAL characteristics of molding sand and the density with which it is rammed in a flask determine whether the gas can escape readily between the grains, or whether a vent wire must be employed to open new and greater passages for the gas and steam to escape. In recent years and in the more modern foundries the tendency has been toward the adoption of a sand sufficiently permeable to dispense with the use of the vent wire. In the accompanying article the author does not consider foundries of this character, but confines his directions to conditions obtaining in the small average foundry where the molder has to rely principally on his own resources and cope with many conditions unknown to the man who works in a foundry where materials and conditions are fairly well standardized. The student never may use a vent wire after he graduates, but he should be familiar with its purpose.

Ramming the sand is an extremely important operation based on the principle that in a well rammed mold, three-quarters of the work is done. Whether the flask is large or small, the principle of ramming is the same. The purpose to be attained is as complete homogeneity as possible.

First, a series of blows is given with the peen end of the rammer, starting from the outside and working toward the center, to ram the sand against the flask. This first ramming though rapid should be light. A second ramming is given with more vigor but not haphazardly, as layers are liable to be created in the flask and one layer will not unite with another. Each layer will not exceed 4 to 5 inches. When the top of the flask is reached, the bars are cleaned with the trowel and the sand rammed vigorously with the butt rammer. This ramming, if well done, stiffens the whole flask. Where the pattern is far enough away, no trouble need be feared when pouring on account of lack of permeability. Where small molds are concerned, a small flask is filled with sand, tramped down with the feet and then rammed with the butt rammer.

Method of Ramming

The center of the mold should not be rammed as hard as the outside or circumference. Greater resistance of the mold is needed at the edges of the flask, where the sand should support its own weight and where less permeability is required.

After ramming the sand with the peen rammer, the molder changes to the butt rammer, starting from a corner and finally working around to the center of the flask. In a round flask the ramming always is started at one side and worked around in a circle toward the center.

The flask could be rammed directly by the rammer without first perform-

ing a general ramming with the hands and feet. The first layer should be rammed lightly and then followed with a ramming increasing progressively in force. However, such a procedure requires more time than the first method outlined.

When the flask is filled with a shallow bed of sand, a large number of light blows should be given with the rammer, with a view of obtaining a comparatively slight compression of the sand. In spite of that care, a zone impermeable to the gases is created where the sand is in contact with the metal, which may cause trouble and defects.

Ramming should be uniform, otherwise the castings will swell where the sand was not rammed sufficiently, while in spots where the ramming was too hard the castings will show scabs. The ramming should be regular to keep the parting real flat. When sand is rammed on sand an awkward blow from the rammer may deform the joint, consequently cause additional work and provide a passage for the escape of metal, later.

Labor Cost Is Increased

In molding without a pattern, sand usually is rammed against sand. If the ramming is irregular, if the sand is rammed too hard in some spots, surfaces with ridges and projections are obtained which increases the difficulty of outlining and finishing the molds, thus increasing the labor cost.

In projecting parts or hollows in the pattern, care will have to be exercised to regulate the blows of the rammer according to the thickness of the sand layer.

For ramming large molds where gaggers and core-irons are used, different methods from those employed in ordinary flasks must be followed. A layer of sand not exceeding 3 inches is spread over the joint. This thin layer is rammed with a short tamper, Fig. 43, a round or square ½-inch bar bent at one end. The tamper is operated with one hand while the other holds the gaggers or soldiers in position. Green sand molds are rammed with average intensity. More force is employed on dry sand molds. The remaining courses of sand are rammed with an ordinary rammer.

Before using the rammer on a barred cope, tamp the sand under edges of the bars close to the joint, with the tips of the fingers. Before setting the cope on the rammed drag, place a ball of sand on each spot where a gate or riser is to be located. Cover the whole surface of the joint with facing sand to a depth of 1 inch. Remove the sand around the edges of the flask with a trowel. Then set the cope in place. Tamp the sand forcibly below the bars with the fingers, both hands working as if they were trying to meet underneath the bars. Tamp the sand finally by the peen end of the ordinary rammer.

By proceeding in the manner outlined a fine cope is obtained. It is not necessary to apply sand to soft streaks under the bars. This is a great advantage. Filling these places with sand is an operation which requires additional labor, makes the joint irregular and favors the leekage of iron. Slicking the mold is detrimental to porosity as it closes the voids.

Molds over 8 inches should be vented. The venting is done by inserting a special needle vertically and at suitable intervals. This leaves openings in the sand for aiding the escape of the gases.

In venting a mold the following points should be kept in mind: A straight line is the shortest distance between two points. Gas is much lighter than air, and has a tendency to rise. For that reason, wherever possible one always should help the gases escape through the cope and not through the drag. Care should be exercised not to obstruct the vents. A stopped vent will prove absolutely useless and even detrimental at times.

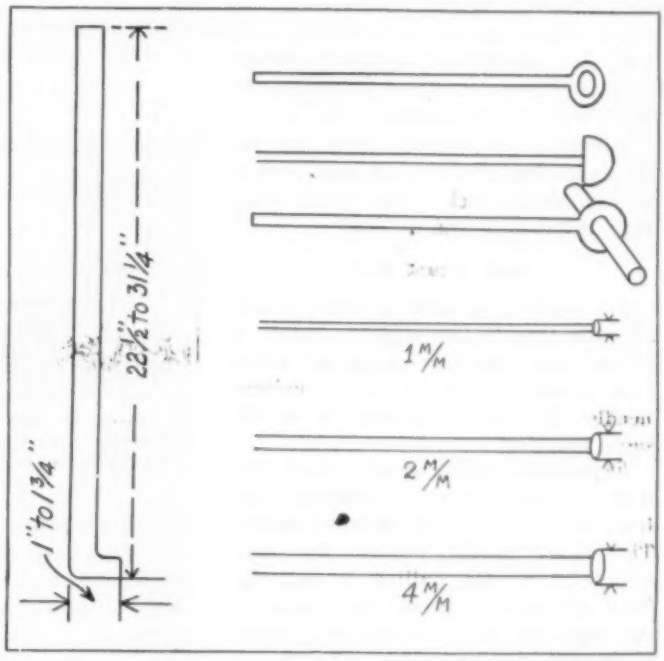


Fig. 43—(Left)—A short round bar with a toe at one end is used for ramming the sand with one hand. Fig. 44—(Right)—Various types of vent wires

Scabs rarely are found on cylinders molded on a loam pattern. The loam pattern is comparatively soft and the blows of the rammer too near the pattern do not produce any spots that are too hard. Hardness of the wood or metal pattern sometimes causes excessively hard parts where the rammer is used too close to the pattern.

Gases originating in the mold at the moment of pouring, commonly are called vents in foundry parlance, and the action of piercing openings through the sand with a steel wire to allow these gases to escape is called venting. In small molds the small volume of gases produced at the time of pouring escape readily through the pores of the sand. In molds prepared for long castings with small cross section, venting is not absolutely necessary. It is not necessary in molds for castings of considerable extent, but with numerous holes through them. In molds for thin columns, wheels with light spokes, etc., it is not necessary to use vent. The question of venting cores will be taken up in a later section.

To make a vent needle with a head, a steel wire is held in a vise and the end is hammered to spread out the metal. When the head becomes worn down it can be spread out again in the same manner as before. First quality spring steel is used for these vent needles. They are strong and their wear is slow. Really they are less expensive than ordinary iron wire which bends upon encountering the least resistance in the sand, and which wears rapidly.

In American foundries the vent wire of any size usually is equipped with either an eye or a head. The head may be of wood or metal. The eye is formed by heating the end of the wire and bending it around any convenient cylindrical object, a rod, a bolt or a piece of pipe. The wood head is attached by forcing the sharpened end of the wire into it. On exceptionally large wires, an eye is formed first in the end of the wire and then a round wood handle 6 to 8 inches in length is placed in the

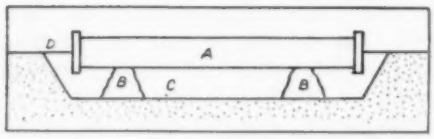


FIG. 45—THE PIPE PATTERN IS SUPPORTED ON TWO MOUNDS OF SAND

eye at right angles to the wire. This type of wire is designed to be wielded with both hands. The metal head or handle, perhaps is the simplest and most popular. A suitable impression is made in the sand and is filled with molten metal. One end of the wire is placed in the metal and held there until the metal solidifies. The lump of metal then is ground smooth and the angles are rounded on a stone. Any one of a number of common objects may serve as a pattern to make the impression in the sand.

Dimensions of several vent needles are shown in Fig. 44. The diameter rarely exceeds ⅜-inch. The length may vary between 1 and 3 feet.

Blunt Point Best

For venting a mold a blunt needle is preferable to one with a point. A novice who has the choice of either kind generally will select a pointed needle. To him it appears to be the more practical.

Experience soon would show him that a blunt needle requires less force to drive than the pointed needle. The blunt needle pushes the sand ahead of it. On pulling it out, the flare of point scrapes the walls of the vent and as a consequence makes a cleaner opening. This aids the escape of the gases.

The pointed needle enters the sand exactly as a wedge and makes openings in which the walls close when the wire is withdrawn and do not permit the gases to escape easily. When the blunt vent wire, Fig. 47, reaches the pattern, it does not hurt it in any way. Furthermore it does not make an opening clear through the mold. The sand pushed ahead of the needle forms a sort of pad against the pattern. The principal advantages of a blunt headed vent wire are the following: Easier for the molder, a really porous passage, good preservation of the patterns.

Therefore only blunt wire should be used for venting molds or cores. The pointed vent wire may be used for molding cast iron core-irons which are used instead of long nails for stiffening molds and cores.

When molding large castings in the foundry floor, it is necessary to place a bed of coke at a depth of 12 inches below the bottom of the mold. This bed has a thickness of 4 to 8 inches, and consists of lumps of coke about the size of eggs. The area is equal to that of the bottom of the casting. Vents made in the bottom of the mold extend into the coke-bed, from which the gases escape through the vent pipe *D* Fig. 46. At the time of pouring, the gas is ignited with a piece of red hot iron, or a chip of wood or paper placed at the pipe opening. Sometimes a few drops of iron are shaken from the skimmer, or the red hot end of the skimmer itself is used for lighting the gas.

The gases which are liberated in the walls of the mold escape through vertical vents. In the mold *B*, Fig. 46, the vents should be made in the bed before ramming the mold. If the molding is done without a pattern, the

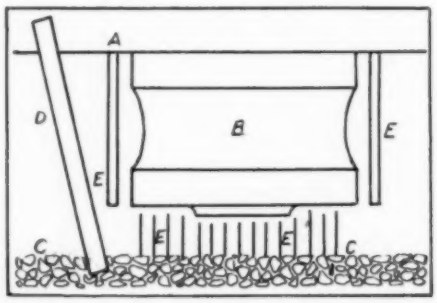


FIG. 46—*A* IS THE FLOOR LEVEL, *B* IS THE MOLD, *C* IS THE COKE BED, *D* IS THE VENT PIPE AND *E* SHOWS THE VENTS

vents are opened down into the coke-bed. Then the tops are closed with the fingers and a little sand. Afterward the sweeping of the mold is completed.

The use of slag or cinders is not advisable as it disintegrates too rapidly, producing small waste particles which become mixed with the molding sand and make it unfit for sweep-molding. It is inadvisable to cover the coke-bed with straw, hay or paper. These materials rot and spoil the sand. They also clog up the mesh of the screen and make screening difficult.

Bedding-in the Patterns

When a flask is lacking and one is obliged to mold in the floor, the pattern must be bedded-in. A trench is dug of the desired size. Then additional sand is removed from the bottom to a depth of 4 to 6 inches for the coke bed. If the pattern is absolutely flat, facing sand to a depth of 1½ to 2 inches is spread over the bottom, then the pattern is laid upon it and pressed down lightly. Then it is removed to see if it bears evenly all over. On spots where the sand is not pressed down, the necessary sand is added. The pattern is replaced on the sand bed and hammered down with a hammer and a wood block. The block of wood protects it and at the same time spreads the blows over the surface of the pattern. The number of blows and their intensity varies according to the extent in area and height of the pattern. Care should be taken to vent the mold.

If the bottom of the pattern has any projections it is set up on supports. If it has cavities, four stakes are driven at four points on the outside to act as guides. The pattern can be taken out as many times as may be necessary and always replaced in its original position. Additional sand is placed where the indications show that it is lacking and then the pattern is definitely impressed. The stakes are taken out and the holes filled.

Weight Pattern Down

The pattern then is weighted down by heavy cast iron weights. The sand is worked in around the outside by a short tamper. More sand then is added and rammed with an ordinary rammer until the opening in the floor is filled.

In the horizontal molding of columns and pipes as shown in Fig. 45, the pattern is supported to a suitable height and level on two small heaps of sand. When it is pressed on these heaps and weighted down, sand is rammed up to the joint. In this way a straight pipe is assured, something impossible if the pattern is pressed down over its entire length.

If the bottom surface of the mold is such that when driving it in with hammer blows the foundation is neither homogeneous nor sufficient, a bed must be made up.

For this purpose two straight edges are laid down level and parallel at either side of the pit bottom. A straight edge is employed to adjust the other two. The straight edge ends rest on cast iron plates or ordinary bricks and are adjusted with wedges. The space between is rammed with

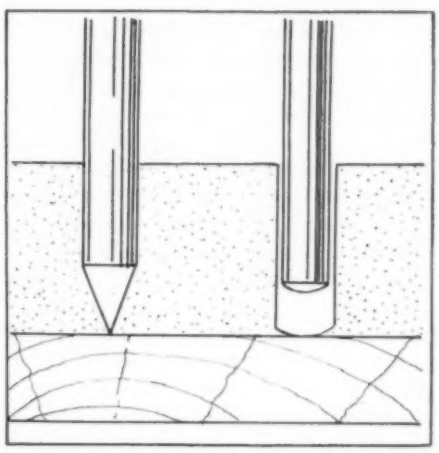


FIG. 47—A BLUNT POINT IS PREFERABLE ON A VENT WIRE

screened floor sand over which a bed of facing sand is placed. Usually a bed of this kind is made dense enough by tramping over it.

The usual coke bed is put down first with a connection to the outside through a pipe. The bed is stricken off level by the third straight edge. The pattern is placed on this bed and the remainder of the mold is finished in the usual manner.

Where bosses, ribs or projections prevent laying the pattern down flat, their position is marked and then the sand is scooped out wherever necessary. As a precautionary measure the pattern is given one or two taps with a hammer, to definitely seat it before starting to ram the sand. Every pattern impressed or placed on a bed should be weighted down, to prevent it from moving during the ramming process. In some cases the pattern is wedged under a cross beam.

Celebrates Golden Anniversary

THE Ajax Metal Co., Philadelphia, one of the oldest American manufacturers of secondary nonferrous ingot metals, founded by J. G. Hendrickson and F. J. Clamer in 1880, is celebrating its fiftieth birthday. Its first location was in a small plant at Ninth and Poplar streets and later the business was moved to Tenth and Diamond streets. In 1888 it was transferred to the present site at Frankford avenue and Richmond street.

Its present output is about 30,000,000 pounds of nonferrous ingots a year and at present it has under construction an addition of 80,000 square feet to its present floor space of 100,000 square feet. This extra space will be devoted largely to the handling and storage of raw material.

Produced Nonferrous Alloys

At the start of its existence, the company produced an alloy for bearings known as Ajax metal. Up to that time it had been the practice in this country to use copper-tin alloys for bearings. Ajax metal was an alloy of copper, tin and lead, the addition of lead giving the alloy increased durability and rendering it less likely to damage from the heat engendered in operation. In its early development, the company also had a rolling mill and produced a general line of nonferrous rolled products. This mill was dismantled and replaced by a department for manufacturing car and locomotive bearings which functioned up to 1928. Today, the company's metal output comprises entirely nonferrous ingots, including a full line of white metal alloys.

An important place in the manufacture of electric melting furnaces also is occupied by the Ajax Metal Co. It was among the pioneers in this line. In 1912 the company started making electric furnaces and subsequently developed a widely used induction type electric furnace. Over 450 of these furnaces have been installed in 46 representative American nonferrous metal melting plants, while 334 have been installed in foreign plants. A new plant for building the induction furnaces recently was completed on the company's site in Philadelphia.

The Ajax Electrothermic Corp., which has a new plant at Ajax Park, near Trenton, N. J., is a unit of the Ajax Metal Co. This company manufactures furnaces of the high frequency, electric induction type, used to some extent in nonferrous melting but principally for melting steel, notably alloy steel. Fifty of these furnaces operated by motor-generator sets, and several hundred operated by static generators already have been placed in operation or are under contract.

G. H. CLAMER

G. H. Clamer, now president and general manager of the Ajax Metal Co. and the Ajax Electrothermic Corp., was one of the first chemists in the brass industry. He was born in Philadelphia and is the son of F. J. Clamer. He was educated in the public schools of that city and then worked for two years in the private chemical laboratory of D. F. A. Genth. Mr. Clamer attended the University of Pennsylvania and in 1897 completed the course in chemistry there. He became connected with the Ajax Metal Co. as chemist and succeeded his father as vice president of the company in 1900. The company was then still relatively small.

Mr. Clamer is recognized as one of the foremost metallurgists in the nonferrous industry and has received several awards for his achievements in the field of metallurgical research. In 1924 he served as president of the American Foundrymen's association, and from 1920 to 1927 served as a member of the board of directors of that association. He also is a past president of the American Society for Testing Materials. Mr. Clamer is a member of the sciences and arts committee of the Franklin Institute, Philadelphia. He continues affiliated with much important work that is in progress for the advancement of nonferrous metallurgy. He also is chairman of a committee seeking to standardize copper alloys used in sand casting.

Test Bond Strength

The engineering experiment station, University of Illinois, Urbana, Ill., recently has published Bulletin No. 200 on the "Investigation of Endurance of Bond Strength of Various Clays in Molding Sand," by C. H. Caseberg and W. H. Spencer. The investigation included a variety of clays used for bonding or rebonding molding sand. Some of the authors' conclusions are: Abnormal bond strength losses on first heating are related to the alkaline or acidic condition of the clays. These losses adjust themselves to normal conditions on additional heating. The endurance of bond strength in a molding sand is dependent on the original bond strength of the clay. Physical and chemical properties of the clay have no appreciable effect on the endurance of the bond strength beyond their effect on the original bond strength. In the absence of facing materials the permeability of a molding sand increases as the clay bond is destroyed. The first heating of sands causes vitrification and the forming of lumps which subsequently are broken up and scattered throughout the sand. Copies of the bulletin are 15 cents.

The Shakeout

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EDWIN BREMER, *Metallurgical Editor*
CHARLES VICKERS, *Nonferrous Editor*
NORMAN F. HINDLE, *Assistant Editor*

¶ Now Is the Time

WITH the advance of the spring season trade reports indicate improving conditions in foundry operations. Manufacturers of foundry equipment, builders of material handling systems and those engineering firms that build complete foundries report a great number of inquiries. However, many of these inquiries which at times in the case of machinery are accompanied by requisitions from the operating departments, are held in abeyance.

One large manufacturer dealing with the foundry industry, the oil industry and the gas industry finds that whereas inquiries are plentiful from the foundry department of their business, actual orders are slack. At the same time the oil machinery department is receiving increasing orders and the period of the year when the demand will be heavy from the gas industry is approaching.

Another case is provided by a heavy machinery firm which at present has eighty men identified with the foundry branch of its business that are practically idle, despite a fair volume of inquiries.

UNDOUBTEDLY the present season in advance of the drive of spring and early summer business is the opportune time for replacing obsolete equipment, repairing or rebuilding that which will need attention and for ordering those sundries of machinery and constructing those additions which will be required with the advent of normal business. The placing of orders at this time will have a stimulating effect. Manufacturing firms can give better service and in some cases are offering better prices than may be obtained later. By making all the required changes which may be necessary to put the plant in shape for efficient operation, delays may be avoided. Obviously, with so many inquiries extant only a slight pickup in orders will be necessary to bring to manufacturing establishments, now operating on reduced schedule, orders which will be in excess of normal capacity and the result will be costly delays in waiting for needed equipment. Manufacturers of equipment, with but few exceptions are carrying low inventories in finished machines. This is another factor in the situation.

The farseeing foundryman who puts his equipment in order at this time will be in a favorable position to meet his customers' requirements.

¶ Stablizing Sales

FOUNDRYMEN have spread before them a living lesson on the benefit of adherence to prices which yield a profit. Producers of several of the commodities now sold to and used largely by foundries perhaps through organized effort have stabilized their prices. This fact is apparent to the purchasing departments of many foundries.

Even in the face of slackened demand the producers of these commodities have stood staunchly for a maintenance of prices. In consequence, the distribution of available orders has been on a basis of service and sales ability of the competing sellers. One salesman whose business is entirely with foundries comments upon the fact that in his territory, in the face of decreased demand, the number of salesmen has increased. At the same time his company is enjoying its normal share of business and every order represents a profit.

Obviously, if firms selling to foundries maintain their price structure under stress, the foundryman, unless he wishes to experience pressure both from above and below, will do well to maintain his price for castings.

¶ Strange Bed-Fellows

THE eighteenth amendment has made some strange bed-fellows. Its effect is felt in many industries that appear to have no connection with the prohibition question. For instance, could there be any connection between the foundry industry and the Volstead act? Most would say, "Not directly."

RECENTLY a patternmaker foreman said that he had found the best solvent for shellac was pure grain alcohol. Now it is impossible to get it. The denatured variety which is available for that purpose does not give satisfaction. When pure grain alcohol was used, patterns coated with shellac were removed from the sand easily. According to the foreman, they now have a tendency to stick and it is his opinion that the denaturants have some effect on the shellac which causes this undesirable property. As a result, the patternshop has had to use a different method for painting its patterns. The effect of the prohibition amendment is seen in strange places.

Comings and Goings of Foundrymen

Men of the Industry, Whose Activities Are Making Foundry History

FREDRICK A. MELMOTH, formerly connected with Thomas Firth & Sons, Sheffield, Eng., manufacturer of steel castings, has been appointed technical director of the Detroit Steel Casting Co., Detroit. Mr. Melmoth was born in Sheffield,

FREDRICK A. MELMOTH

England, and received his technical education at Sheffield university. In 1913 he was appointed to an associateship in metallurgy and was awarded the Mappin medal. Mr. Melmoth received his early experience at the Brown Baily Steel Works, Sheffield, where he served in the offices of the company and as assistant in the research laboratories. In 1914 he was placed in charge of the night shift in the open-hearth department. During his service in that department, he engaged in the development of stainless steels. In 1916 Mr. Melmoth became associated with the National Steam Car Co., Chelmsford, Eng., where he remained for 2 years as foundry manager. It was while at this plant that he first became interested in the production of steel castings. In 1918 he joined the Lake & Elliot Co., Braintree, Essex, Eng., as foundry steel maker. He was placed in charge of the foundry in 1920 and at the same time was appointed consultant for the National Steel Foundry Co., Leven, Fifeshire, Scotland. About 4 years ago he was placed in charge of the foundry of Thomas Firth & Sons, Sheffield. Mr. Melmoth has contributed many articles to the technical press both of the United States and Great Britain.

R. I. Van Winkle has been appointed manager of the Wandtke Pattern & Foundry Co., 1700 Ohio avenue, Anderson, Ind.

Hyman Bornstein, chief chemist and metallurgist, Deere & Co., Moline, Ill., addressed the Quad-City Foundrymen's association at its regular monthly meeting held at the Chamber of Commerce, Davenport, Iowa, Feb. 24. Mr. Bornstein spoke on "Factors Affecting Quality in the Foundry."

Fred O. Reemer, formerly director of the southern interests of the Pullman Car & Mfg. Co., at Birmingham, Ala., has been elected vice president of the company in charge of southern operations. Prior to his recent appointment Mr. Reemer was in charge of purchases for the company at Chicago.

E. L. Roth, for the past 3 years associated with the Steel Sales Corp., Chicago, as foundry engineer representing the International Nickel Co., New York, has been appointed general manager of the Motor Castings Co., Milwaukee. Prior to his connection with the Steel Sales Corp., Mr. Roth

E. L. ROTH

was associated with the Diamond Chain & Mfg. Co., Indianapolis, and before that was connected with the McQuay-Norris Co., Connersville, Ind. He was graduated from the University of Cincinnati with the degree of mechanical engineer.

LAMAR S. PEREGOY

Lamar S. Peregoy, formerly vice president, secretary and general manager of the Sivyer Steel Casting Co., Milwaukee, has been elected president of the company recently formed by the merger of the Sivyer Steel Casting Co. and the Nugent Steel Castings Co., Chicago. Mr. Peregoy has been connected with the Sivyer company since its inception in various capacities. In February, 1929, he was elected general manager of the company. Mr. Peregoy also is a director of the Interstate Drop Forge Co., and of the Federal Malleable Co., both of Milwaukee and affiliated with the Sivyer company.

A. D. Jackson has been re-elected president of the Western Malleables Inc., Beaver Dam, Wis. Other officers include C. A. Starkweather, vice president; H. L. Kirsh, vice president and general manager; R. J. Klatt, secretary and treasurer. The company was organized several years ago to take over the foundry of the Western Malleables Co.

C. J. White, formerly foundry foreman, Lima Locomotive Works, Lima,

O., recently resigned that position to become foreman at the Bass Foundry & Machine Co., Fort Wayne, Ind. Mr. White began his foundry career in 1905 with the Champion Engineering Co., Kenton, O., and remained in its employ for 14 years. During that period he rose to foundry foreman which position he resigned to accept a similar position with the Lima Locomotive Works. He remained in the employ of that company for 7 years when he resigned to accept his present positon.

William Hastings Bassett, technical superintendent and metallurgist of the American Brass Co., Waterbury, Conn., has been elected president of the American Institute of Mining and Metallurgical Engineers. Mr. Bassett was graduated from Massachusetts Institute of Technology in 1891 and has been active in metallurgical work since that time. Following his graduation he accepted a position as chemist for the Pope Island Mfg. Co., where he served until 1895 when he accepted a position as teacher of chemistry in Swain Free school. He continued in that capacity for several years after

W. H. BASSETT

which he became connected with the New Jersey Zinc Co., New York, for two years and for the next nine years was chief chemist and metallurgist, Coe Brass Co., Farmington, Conn. He was appointed to his present position in 1912.

Guy E. Lown has resigned after having been identified with the Johnston Harvester Co., and its successor, the Massey-Harris Co., Batavia, N. Y., for more than 32 years. Since 1897 he has filled such positions as time clerk, stock clerk, cost clerk, purchase clerk, and paymaster in charge of time keeping, payroll and cost department. In 1907 he became purchasing agent and in 1925 he was elected a director and made treasurer. In August, 1928, when the company was consolidated with the J. I. Case Co., Racine, Wis., he was made assistant to the general manager.

Carl G. Schluederberg, formerly general manager of the street lighting department, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., and located at South Bend, Ind., has been appointed works manager of the Cleveland plant of that company. Mr. Schluederberg attended Cornell university from which he was graduated in 1902. The same year he entered

Foundry Association Directory

American Foundrymen's Association

President, FRED ERB, Erb-Joyce Foundry Co., General Motors building, Detroit; executive secretary treasurer, C. E. HOYT, 222 West Adams street, Chicago; technical secretary, R. E. KENNEDY, 222 West Adams street, Chicago.

Associated Brass Founders of New England

President, GEORGE W. THORNBURG, Crescent Park Brass Foundry, Watham, Mass.; secretary, R. B. BONNER, Somerville Machine & Foundry Co., 14 Kent street, Somerville, Mass. Meeting the fouth Wednesday of each month at the Engineers' club, Boston.

The Buffalo Foundrymen

President, J. MCARTHUR, Washington Iron Works; secretary, W. J. WARK, E. J. Woodison Co., 140 Chandler street. Meetings each month at club rooms, 140 Chandler street.

Central Illinois Foundrymen's Club

President, H. M. HIRE, Hire Foundry Co., Peoria, Ill.; secretary, FRANKLIN WHITEHEAD, The Meadows Mfg. Co., Bloomington, Ill.

Chicago Foundrymen's Club

President, H. P. EVANS, Pettibone-Mulliken Co.; secretary, ALBERT N. WALLIN, S. Obermayer Co., 2563 West Eighteenth street. Meetings first Thursday in each month at the City club, 315 Plymouth court.

Connecticut Foundrymen's Association

President, CARL S. NEUMANN, Union Mfg. Co., New Britain, Conn.; secretary, CHARLES S. PARKER, Charles Parker Co., Meriden, Conn. Meetings are on second Friday of each month in various parts of the state.

Detroit Foundrymen's Association

President RUSSELL M. SCOTT, Packard Motor Car Co., Detroit; secretary, WILLIAM J. MUHLITNER, Great Lakes Foundry Sand Co., 2100 Penobscot building, Detroit. Meetings third Thursday in each month except December, June, July and August at Masonic temple.

East Bay Foundrymen's Association

Secretary O. R. MOLLER, Electric Steel Foundry Co. Inc., 1328 Second street, Berkeley, Calif.

Electric Steel Founders' Research Group

Director, R. A. BULL; Assistant Director, C. N. RING; Central Office, 541 Diversey Parkway, Chicago.

Gray Iron Institute

President, WALTER L. SEELBACH, Forest City-Walworth Run Foundries Co., Cleveland; secretary, ARTHUR J. TUSCANY, Terminal Tower building, Cleveland.

Malleable Iron Research Institute

President, R. R. FAUNTLEROY, Moline Malleable Iron Co., St. Charles, Ill.; secretary, ROBERT E. BELT, Union Trust building, Cleveland.

Metropolitan Brass Founders' Association

President WILLIAM EMBER, Jefferson Brass Foundry, 62 Delevan street, Brooklyn, N. Y.; secretary, WILLIAM E. PAULSON, Thomas Paulson & Son Inc., 97 Second avenue, Brooklyn, N. Y. Meeting second Wednesday in each month at the Building Trades club, 2 Park avenue, New York.

Newark Foundrymen's Association

President, J. L. CARTER, Sachs-Barlow Foundries, Inc., Newark; secretary, W. H. MANTZ, Atlas Foundry Co., Irvington, N. J. Meeting called by president.

New England Foundrymen's Association

President, ERNEST F. STOCKWELL, Barbour-Stockwell Co., Cambridge, Mass.; secretary FRED F. STOCKWELL, 205 Broadway, Cambridgeport, Mass. Meetings second Wednesday of each month at the Exchange club, Boston. Outings usually are held in the summer months.

Ohio Foundries Association Inc.

President, DON MCDANIEL, Hamilton Foundry & Machine Co., Hamilton, O.; secretary-manager, E. F. SCOTT, 418 Penton building, Cleveland.

Philadelphia Foundrymen's Association

President, C. F. HOPKINS, Ajax Metal Co., Philadelphia; secretary, EARL SPARKS, 1623 Sansom street, Philadelphia. Meetings the second Wednesday of each month at the Manufacturers' club.

Pittsburgh Foundrymen's Association

President, L. W. MESTA, Mesta Machine Co., Homestead, Pa.; secretary-treasurer, WILLIAM J. BRANT, Wm. J. Brant, Bessemer building, Pittsburgh. Meeting on the third Monday of the month, except in July and August at Fort Pitt hotel.

Quad-City Foundrymen's Association

President, F. W. KIRBY, John Deere Spreader Works, East Moline, Ill.; secretary-treasurer, J. P. BOADEN, Union Malleable Iron Co., East Moline, Ill. Meetings the third Monday of each month, the meeting place being rotated between Moline, Rock Island and Davenport.

St. Louis District Foundrymen's Club

President, HORACE R. CULLING, Carondelet Foundry Co., St. Louis; secretary-treasurer, LEO J. FILSTEAD, John C. Kupferle Foundry Co., St. Louis.

Southern Metal Trades Association

President, JOHN S. SCHOFIELD, J. S. Schofield's Sons Co., Macon, Ga.; Secretary, W. E. DUNN Jr., Flatiron building, Atlanta, Ga.

Steel Castings Development Bureau

Research Director, GEORGE BATTY, 500 Stock Exchange building, Philadelphia.

Steel Founders' Society of America

President, J. E. MCCAULEY, Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa.; managing director, G. P. ROGERS, Graybar building, New York. Meetings: Cleveland, May 12-15, 1930.

Tri-City Technical Council

Chairman, C. F. SCHERER, Davenport Machine & Foundry Co., Davenport, Iowa; secretary, E. C. XANDER, assistant secretary, Tri-City Manufacturers association, Moline, Ill. Combined meetings held only one or two times a year on call.

Tri-State Foundrymen's Association

President, WILLIAM HOPPENJANZ, The Star Foundry Co., 221 Main avenue, Covington, Ky.; secretary, C. C. Erhart, Chris Erhart Foundry Co., Cincinnati. Meetings the second Thursday of each month at the Cincinnati club, Eighth and Race streets.

Twin City Foundrymen's Association

President, R. D. BONNEAU, Commutator Co., Minneapolis; secretary-treasurer, C. E. LANGDON, 3849 Lyndale avenue, south, Minneapolis. Meeting third Wednesday of each month at Athletic club.

Washington Foundrymen's Club

President, J. W. ORPHAN, Lake Union Foundry Co., 1703 Westlake avenue, Seattle; secretary, EDWARD C. GUSTIN, The Prescott Co., 1 West Lander street, Seattle. Meetings second and fourth Tuesdays of each month at the Elks Temple, Fourth avenue and Spring street.

Western Foundrymen's association

President, H. T. HORNSBY, Joplin, Mo.; secretary, E. L. GRAHAM, Acme Foundry & Machine Co., Coffeyville, Kans.

Wisconsin Gray Iron Foundry Group

Secretary, W. F. BORNFLETH, Cutler-Hammer Inc., Foundry Division, Milwaukee. Meetings on first Wednesday of each month at Hotel Schroeder, Milwaukee.

the employ of the Westinghouse company. Later he was placed in charge of the supply sales division. He retired in 1905 to take graduate work at Cornell university leading to a doctor's degree in philosophy. During the years 1908 and 1909, he traveled in Europe, investigating economic and industrial conditions. Upon his return to the United States, he joined the Carnegie Steel Co., now a branch of the United States Steel Corp., New York, as metallurgical engineer. He returned to the Westinghouse company in 1910, and since that time has served as commercial engineer, manager of the switchboard section, assistant manager of the supply and merchandising departments, and general manager of the street lighting department. In his new position, Mr. Schluederberg will have charge of the South Bend plant, until its facilities are moved to Cleveland, and the St. Louis plant.

Hear Talk on Bearings

The regular monthly meeting of the Philadelphia Foundrymen's association was held Feb. 12, at the manufacturers' club. The meeting was addressed by W. M. Corse, a past president of the Detroit Foundrymen's association and secretary of the Institute of Metals division of the American Institute of Mining and Metallurgical Engineers. Mr. Corse had for his subject, "Bearings and Bearing Metals." Mr. Corse has been connected with the operating end of the brass foundry industry for the past 25 years and for the past 7 years has been acting as a consultant on nonferrous metals and alloys.

Sivyer and Nugent Steel Foundries Combine

Directors of the Sivyer Steel Casting Co., Milwaukee, and the Nugent Steel Castings Co., Chicago, have voted to combine the two companies under the name of the Sivyer Steel Casting Co. Both foundries specialize in the production of electric steel castings of the carbon and alloy varieties. They have been active in research and in the pioneering of alloy steel castings to meet special conditions.

The new company will have a monthly production capacity of 1400 tons. The Sivyer Steel Casting Co. was organized in 1909 and is equipped with two electric furnaces of 1 to 3 tons capacity. The Nugent Steel Castings Co. is equipped with two electric furnaces of 1 to 4 tons capacity.

Lamar S. Peregoy, formerly vice president of the Sivyer Steel Casting Co., has been elected president of the combination and C. R. Messinger, formerly president of the same company has been elected chairman of the board.

Paxton-Taggart Inc., 112 Point street, Philadelphia, has moved its New England offices and warehouse to the Barstow building, Providence, R. I.

Connersville Blower Elects Officers

The Connersville Blower Co. Inc., Connersville, Ind., recently elected the following officers at a meeting of the board of directors: John T. Wilkin, president, chief engineer and general manager; Bernard C. O'Brien, formerly in charge of the Pittsburgh sales office, secretary; W. E. Newkirk, purchasing agent and treasurer, and E. C. Hassler, formerly assistant superintendent, superintendent. The latter three selections were to fill vacancies caused by the deaths of J. E. Huston, secretary and treasurer, and R. T. Huston, vice president and superintendent.

Newark Founders Meet

The regular monthly meeting of the Newark Foundrymen's association was held at the Down Town club, corner of Broad and Market streets, Newark, N. J., Feb. 25. The meeting was held as a district conference of gray iron foundries with the program arranged by the Gray Iron institute. A. J. Tuscany, manager of the institute, was the principal speaker. He outlined the activities of the institute and discussed the standard cost system which it recently submitted to the industry and which was published in THE FOUNDRY. He also spoke on uniform trade customs and the institute's plan for the development of recommended practices for gray iron foundries throughout the country.

The Foundry to Present a Series of Articles on Analysis and Testing of Molding Sand

THOUSANDS of dollars worth of castings are lost every day in foundries throughout the country due to improper conditions of the molding sand used. Many times these losses are attributed to other than the right cause. Foundrymen exert the greatest care in establishing and maintaining the correct mixtures and cupola practice, but fail to exert a like vigilance over their molding sand conditions. While attention to the molding sand condition is not a cure-all for foundry difficulties, the position of molding sand in foundry operation is of sufficient importance that it should receive the same attention as is devoted to metal mixing, cupola operation, molding method, etc.

Beginning with the March 15 issue THE FOUNDRY *will present a series of articles devoted to the analysis and testing of molding sands. These articles also will provide information on the interpretation and application of the data obtained from the tests, which will enable the foundryman to procure the best efficiency and economy in the use of molding sand and molding sand mixtures which he uses in the foundry.*

Included in the articles will be the history of sand testing and the development of some new methods with comparisons with other methods. Interpretation and application of laboratory results will cover sand mixing by analysis, sand equilibrium in the foundry, importance of proper sand handling and mixing, use of sea coal and test data. The series also will describe reclamation of waste molding sand and the utilization of burnt core sand or cleaning room sand for molding sand purposes. Molding sand bonding materials and their evaluation also will be discussed.

Tri - State Foundrymen Elect Officers

The regular annual meeting of the Tri-State Foundrymen's association was held at Cincinnati, Feb. 13. The following officers were elected for 1930: William Hoppenjans, Star Foundry Co., Covington, Ky., president; George Johnson, Reliance Foundry Co., Cincinnati, vice president; Charles B. Erhart, Chris Erhart Foundry Co., Cincinnati, treasurer, and C. C. Erhart, Chris Erhart Foundry Co., Cincinnati, secretary.

Officers Are Elected

Stockholders of the Paxton & Vierling Iron Works, Omaha, Nebr., recently elected the following board of directors: A. J. Vierling, F. R. Vierling, B. J. Scannell, F. H. Marsh, and J. H. Merz of Omaha and L. Vierling and C. J. Vierling of Chicago Following the stockholders' meeting the board of directors elected the officers of the company who include A. J. Vierling, president; Louis Vierling, vice president, B. J. Scannell, treasurer, and F. R. Vierling, secretary.

Celebrates Anniversary

Richard-Wilcox Co., Aurora, Ill., has issued a special number of its house organ "Door-Ways" in celebration of the golden anniversary of the company. The booklet tells of the development of the line of door products that the company manufactures and also gives a historical outline of the growth and evolution of the company. The remainder of the booklet is devoted to illustrations and descriptions of typical installations of the company's doors of various designs.

Will Address Chicago Foundrymen's Club

Dan M. Avey, editor, THE FOUNDRY, Penton Publishing Co., Cleveland, will be the speaker at the March 6 meeting of the Chicago Foundrymen's club. Plans for the April meeting include a special session on steel foundry practice. The club has received an invitation from the Quad-City Foundrymen's association to attend the round-table and plant visitation meeting to be held in Moline, Ill., under the auspices of the Quad-City group and the American Foundrymen's association, March 26.

Engineering Properties of Cast Iron

(*Concluded from Page* 110)

demonstrated by Fig. 17. The black line of fracture passes right through the white steadite crystal.

Thus, it is obvious that the strength of the metal is to a large degree dependent on the degree of separation of the graphite flakes, and on the strength of the intervening matrix. The fewer the graphite flakes, the smaller their size, and the more favorable their distribution, the stronger the metal, other factors equal. With graphite flake structure the same, irons of pearlitic matrix are naturally stronger than are irons of ferritic matrix. Large amounts of steadite are considered detrimental to strength. This component is brittle, minimizing ability of the metal to undergo plastic readjustment. The effect of steadite is most detrimental when the load is suddenly applied. Sudden concentrations and release of internal load due to the presence and reactions of this component causes the metal to act as a brittle material.

Indianapolis Founders Elected Officers

Indianapolis Foundrymen's association elected the following officers at a meeting held at the Columbia club, Indianapolis, Feb. 5: Frank O'Neill, president; Guy E. Street, vice president, and James H. Hooker, secretary. The following members were elected to the board of directors: Thomas A. Lavelle, W. D. Hamerstadt and E. P. Gramling. Other directors include J. B. Lewis and T. J. Cornwell.

Knoxville Sand & Lime Co., Knoxville, Tenn., has been appointed representative of the Ironton Fire Brick Co., Ironton, O.

Austin Company Officials Sail for Russia

C. W. WOLFE and F. A. Coleman, vice president in charge of foreign operations and foundry expert respectively, Austin Co., Cleveland, sailed from New York on Feb. 15 *on the* S. S. MINNEWASKA *enroute to Russia to supervise the preliminary work on the* $40,000,000 *automobile plant and industrial city that that company is designing and building for the Soviet government at Nizhni Novogorod. They will remain in Russia for two years or longer.*

Mr. Wolfe will take charge of operations at Nizhni until the arrival of H. F. Miter, vice president in charge of the company's foreign department, with the main contingent of approximately 20 *engineers and technical experts. Mr. Coleman will assist Mr. Wolfe in the supervision of the preliminary work on the project and in addition will conduct sales work in Russia.*

Mr. Wolfe has been a member of the Austin organization since 1923 *and prior to his appointment to the foreign department, had been superintendent of construction. He also was employed in the company's estimating department. Prior to Mr. Coleman's employment by the company, he was head of the F. A. Coleman Co., manufacturer of industrial ovens.*

Trade Trends in Tabloid

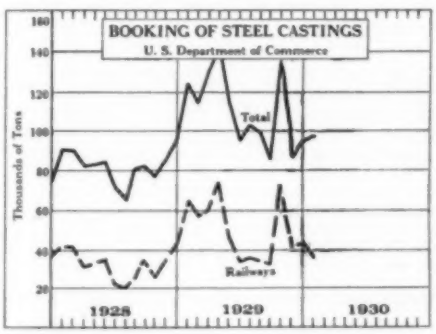
OHIO foundry operations improved slightly during January, according to the monthly report issued by E. F. Scott, secretary-manager, The Ohio Foundries Association Inc. January shows operations at 82.4 per cent, compared with 73.5 per cent for December.

—T—T—

Malleable foundries making railway and agricultural work are more active in the Chicago district and some improvement is noted in automotive specifications.

—T—T—

Buying of foundry pig iron is light in the Philadelphia district. In a number of cases, melters have increased their operations and the purchases of scrap indicate larger percentages of scrap in cupola charges.



—T—T—

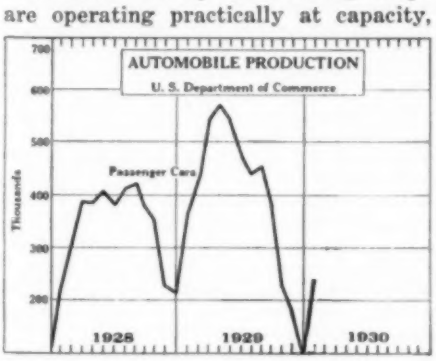
Fulton Iron Works Co., St. Louis, has closed a one hundred fifty thousand dollar contract for sugar machinery to go to Mexico for a company headed by former President Calles.

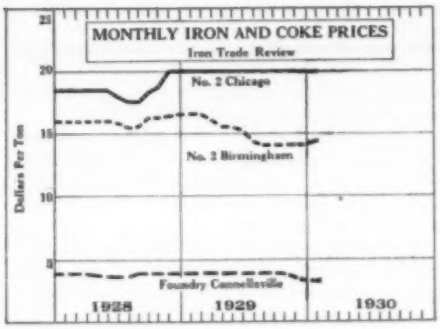
—T—T—

Buying of nonferrous metals is light in the closing weeks of February, according to New York reports but shipments are going ahead under orders placed earlier. Combined deliveries of brass and bronze ingots for January totaled 6154 tons, according to the Nonferrous Ingot Metal institute. December totaled 5167 tons.

—T—T—

Western railway car building shops are operating practically at capacity, on orders that will carry through until late in June. Freight movement for the last week in January was the largest for 1930. The total car loadings for the week of Feb. 1 were 898,894 as compared with 934,154 cars for the corresponding week in 1929.





—T—T—

Canada Iron Foundries, Ltd., Montreal, operating shops at Montreal and Three Rivers Que. and St. Thomas, Hamilton and Fort William, Ont. report profits in 1929 over one hundred forty thousand dollars ahead of 1928.

—T—T—

Cast iron pipe interests are entering the pig iron market in the south, while operations continue steady. Radiator shops in the southern district are operating at the rate of five days a week.

—T—T—

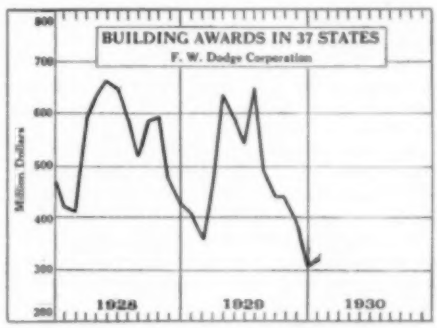
Malleable casting production declined in January, according to the department of commerce. The total for the first month of 1930 was 44,680 tons compared with 48,202 tons for December, 1929. Operators average 56.2 per cent of capacity.

—T—T—

January building construction contracts were 21 per cent under the total for the same month in 1929, according to F. W. Dodge Corp., but were ahead of December. This is the first time in nine years that the January total has exceeded the preceding December.

—T—T—

Steel foundry operations for January average 70 per cent of capacity, according to the department of commerce, compared with 73 for December and an average of 77 for the entire year. Orders increased from 65 per cent in December to 67 in January, with miscellaneous showing the greatest pickup.



—T—T—

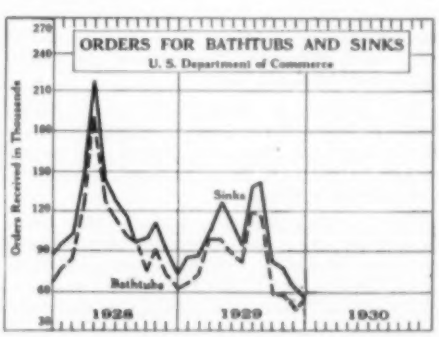
Steel plant operations have risen to the level of mid-October, 1929, with the average for the entire industry about 81 per cent of capacity. The peak for last year was reached in August with 96 per cent attained.

—T—T—

The National Business Survey conference, Washington reports forty-four million people at present employed, or greater than ten million more persons employed than at the same period in 1921. Wage rates have remained practically the same as during 1929.

RAW MATERIAL PRICES
Feb. 24, 1930

Iron	
No. 2 foundry, Valley	$18.50
No. 2 Southern, Birmingham	15.00
No. 2 foundry, Chicago	20.00
No. 2 foundry, Philadelphia	20.76
No. 2 foundry Buffalo	18.50
Basic, Valley	18.50
Basic, Buffalo	18.00
Malleable, Chicago	20.00
Malleable, Buffalo	19.00
Coke	
Connellsville beehive coke	$3.50 to 4.85
Wise county beehive coke	4.25 to 5.00
Detroit by-product coke	9.00
Scrap	
Heavy melting steel, Valley	$16.50 to 17.00
Heavy melting steel, Pitts	16.75 to 17.25
Heavy melting steel, Chicago	13.50 to 14.00
Stove plate, Buffalo	12.50 to 12.75
Stove plate, Chicago	10.75 to 11.25
No. 1 cast, New York	10.85
No. 1 cast, Chicago	13.50 to 14.00
No. 1 cast, Philadelphia	15.50 to 16.00
No. 1 cast, Pittsburgh	14.50 to 15.00
No. 1 cast, Birmingham	12.00 to 13.00
Car wheels, iron, Pittsburgh	14.50 to 15.00
Car wheels, iron, Chicago	14.00 to 14.50
Railroad malleable, Chicago	16.50 to 17.00
Agricultural mal., Chicago	13.75 to 14.25
Malleable, Buffalo	17.00 to 17.50
Nonferrous Metals	**Cents per pound**
Casting, copper, refinery	17.12½ to 17.25
Electro, copper, producers	18.00
Straits, tin	38.37½
Lead, New York	6.25
Antimony, New York	9.00 to 9.12½
Nickel, electro	35.00
Aluminum, No. 12, producers	23.00
Aluminum, No. 12, remelt	16.25 to 16.75
Zinc, East St. Louis, Ill.	5.15



What the Foundries Are Doing

Reflecting the Activities of the Gray Iron, Malleable, Steel and Brass Shops

American Foundry Co., Indianapolis, which recently was badly damaged by fire, will rebuild the damaged buildings. (Noted Feb. 15.)

Akron Foundry Co., Akron, Ind., has closed but it is expected that it will be reopened under new management soon.

Bassett Foundry Co., Adrian, Mich., has been incorporated with $5000 capital to make ferrous and nonferrous castings.

West Newton Foundry Co., West Newton, Pa., a new organization, will locate a plant in the south end of West Newton.

Pioneer Foundry Co., Waukesha, Wis., has sold its former site and building, and possibly will erect a foundry on another site.

Grand Rapids Brass Co., Front avenue northwest, Grand Rapids, Mich., suffered a small loss by fire recently.

Turner Brass Works, Sycamore, Ill., is installing a tramrail and roller conveyor system in its foundry.

Plans for the merger of the Sterling Range & Foundry Corp. and the Co-operative Foundry Corp., both of Rochester, N. Y., have been abandoned.

Big Four Foundry Co., 301 North Hartford street, Tulsa, Okla., will build a pattern shop and storage addition, 30 x 100 feet. Clarence Jeffries is superintendent.

Sterling Steel Foundry, Eighth street and Pittsburgh & Lake Erie railroad, Braddock, Pa., recently suffered a small fire loss in the pattern shop.

Lakeside Malleable Castings Co., Racine, Wis., has increased its capitalization from $100,000 to $200,000 to acquire the Wisconsin Malleable Iron Co., Milwaukee.

Aluminum Industries Inc., 2439 Beekman street, Cincinnati, has awarded contracts for foundry and machine shop buildings to cost about $100,000. Ray T. Meeker is secretary.

Charles E. Koehler, Gray and Emerson streets, Hamilton, O., has been granted a permit for a foundry addition at 706 South Eighth street.

Perfect Circle Co., Hagerstown, Ind., contemplates building a foundry addition at New Castle, Ind., which will cost approximately $50,000.

Chattanooga Stove & Foundry Co., Forty-third street and Belt railroad, Chattanooga, Tenn., has let contract to John Parks Co., 315 Oak street, for foundry building. (Noted Jan. 15.)

Electric Steel Foundry Co., 1328 Second street, Berkeley, Calif., will double plant capacity with construction of an addition to cost more than $50,000.

Birdsboro Steel Foundry & Machine Co., Birdsboro, Pa., care M. E. Post, plans, a 1-story plant to cost approximately $30,000. Owner is receiving bids on general contract.

Beaumont Iron Works, 1450 Crockett avenue, Beaumont, Tex., has placed contract for extension to foundry building and necessary equipment with Tellepsen Construction Co., 3900 Caly street, Houston, Tex.

Troy Engine & Machine Co., Land Title building, Philadelphia, plans a plant alteration and addition at Troy, Pa. Plans are being revised by W. E. S. Dyer, engineer, Land Title building, Philadelphia.

West Virginia Foundry & Stove Co., Huntington, W. Va., has purchased the Treasure Stove Co., Gallipolis, O., all physical properties of the latter company will be taken to Huntington. Ground has been broken for the first of two additional buildings at Fourth avenue and Twenty-fourth street, Huntington.

Koken Companies Inc., 3400 Morganford road, St. Louis, manufacturer of metal chairs and metal products, have awarded contract for a 1-story addition, 80 x 100 feet, to cost with equipment about $40,000.

General Bronze Corp., 1655 Booth street, Milwaukee, formerly known as the Wisconsin Ornamental Iron & Bronze Co., will erect foundry, 100 x 200 feet. E. A. Ernst is general manager.

Crucible Steel Casting Co., Almira avenue and West Eighty-fourth street, Cleveland, advises that a new melting unit will be included in its new foundry and storage addition. (Noted Feb. 15.)

National Lock Co., 1930 Seventh street, Rockford, Ill., recently has increased its foundry capacity. The company also has installed an electric furnace and other equipment in the foundry.

Grinnell Co., 30 East Fourth street, Charlotte, N. C., maker of pipes, valves and fittings is preparing plans for a new plant to replace present unit at North Charlotte, N. C. J. E. Sirrine & Co., 215 South Main street, are consulting engineers.

Cleveland Production Co. has been incorporated in Wilmington, Del., temporarily with $1,000,000 by the Corporate Trust Co. of America, Fidelity Philadelphia building, Philadelphia, to own and operate foundries and machine shops.

American Metals of Canada Ltd., Copper Cliff, Ont., has been incorporated by Norman E. Strickland, attorney, 123 Rose Park drive, to refine and trent copper and other metals and to carry on the business of founder and metal manufacturer.

Scottdale Machine, Foundry & Construction Co., Scottdale, Pa., will enlarge its plant with an addition that will double capacity and production. Plant will be steel structural building, 50 x 100 feet, and work will begin at once.

Buckeye Steel Castings Co., South Parsons avenue, Columbus, O., will spend approximately $120,000 during the year for alterations to its foundry building. This includes the installation of sprinkling equipment and the building of crane operating space.

Gervais Iron Works, for many years operating at Benton Harbor, Mich., is moving to Chicago where it will have a plant at 3422 Normal avenue, in connection with the Butler Street Foundry Co. Ornamental and miscellaneous building specialties will be produced as in the past. L. L. Gervais is manager.

Calgary Iron & Foundry Ltd., Calgary, Alta., founders, machinists and welders, 410 East Ninth avenue, advises that it has absorbed the Calgary Iron Works Ltd. The foundry company proposes to add structural and blacksmith shops. Machinery needed includes an openside planer, turret lathe, steam or air hammer and molding machines.

Ruddy Mfg. Co., Aurora, Ill., which recently was incorporated to operate a pattern shop for the manufacture of wood and metal patterns, has moved into its new plant at Jackson street and Joliet & Eastern railroad. J. M. Ruddy is president of the company. Other officers include Gerald Wiley, secretary and treasurer, and H. E. Reid, manager.

Usona Mfg. Co., 512-26 Chouteau avenue, St. Louis, is building an addition to its plant. The new unit is a nonferrous foundry, 30 x 75 feet, for the production on bronze, aluminum and possibly monel metal castings. Complete equipment for the building will be purchased. Kremer & Voirol Construction Co., St. Louis, are the contractors.

Springfield Bronze & Aluminum Co., Springfield, Mass., is about to occupy additions to its plant, 30 x 140 feet, 60 x 60 feet and 30 x 60 feet. The larger building will house offices, locker rooms and pattern shops, the second molding and manufacturing space and the latter pattern storage. Joseph R. Gould is president and J. C. Tarbell treasurer.

Egyptian Foundry & Mfg. Co. Inc., Belleville, Ill., has bought the plant of the Lincoln Foundry Inc. and will continue the manufacture of stoves and castings and a general jobbing business. Officers of the new company, which has just completed organization, are: President, William Arey; vice president, Frank J. Wagner; second vice president, Ewald Glueck; secretary, Edward A. Ruff; treasurer, Fred Roesch; manager, Minard Van Eisenga. Alex Ehret and Erwin Ehret, president and secretary of the former Lincoln foundry, are building a foundry at Mt. Carmel, Ill.

New Trade Publications

FLUXES—The Mathieson Alkali Works, 250 Park avenue, New York, has issued a folder on the development of its flux and its chemical properties. Its relation to the metallurgy of cast iron also is discussed.

ARC WELDING — Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has issued a folder which discusses the welding of cast iron. Various processes are described and discussed and arc welding procedure for the repair of castings is explained.

CONVEYORS—Universal System of Machine Moulding & Machinery Co., Ltd., 13/15 Wilson street, London, E. C. 2, has issued a folder on the new type roller conveyor that it makes. The advantages of the new equipment, details of construction and specifications are given.

MOLDING MACHINES—Milwaukee Foundry Equipment Co., Milwaukee, has issued a 24-page catalog of the molding machines that it manufactures. Each machine is described in detail and specifications are given. The booklet also contains many illustrations of typical installations. Letters of recommendaton are included on several pages of the catalog.

ARC WELDERS—General Electric Co., Schenectady, N. Y., has issued two folders on its gas-engine-driven arc welders. One has a rating of 300 amperes, 25 volts, 1 hour, 50 degrees Cent. and is driven by a Buda gas engine. The other has a rating of 200 amperes, 25 volts, 1 hour, 50 degrees Cent., and is driven by a Continental unit.

ALUMINUM — Aluminum Co. of America, Pittsburgh, has issued a folder on the welding of aluminum. The process is described and sketches show the various types of flames used. Points to be remembered in the selection of fluxes and welding wire are discussed as is the technique of the job. Tables show the physical properties of welded and unwelded structures. The booklet is done attractively and contains many illustrations of processes and tools.